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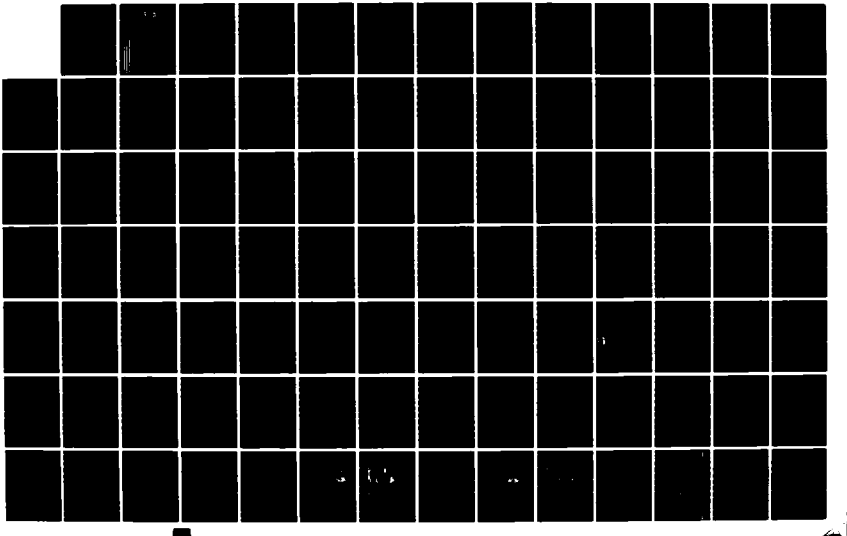

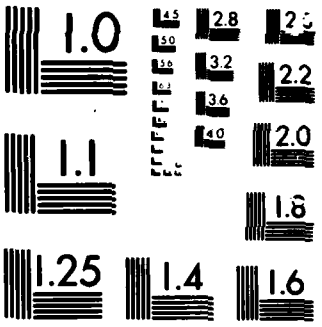

MICROCOPY CHART

INSTALLATION PLAN

PIER BUOY MOORING PROJECT
AND
MAINTENANCE TO EXISTING MOORING
DIEGO GARCIA B.I.O.T.

BY
K. COOPER

FPO-1-80 (3)
JANUARY 1980

APPROVED BY

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OCEAN ENGINEERING
AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
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1.0 INTRODUCTION

Design of the buoy-dolphin mooring system for the Diego Garcia pier was driven by operational requirements, installation constraints and environmental considerations which make the moorings quite different from standard Navy Fleet Moorings. These differences make the installation of the moorings more critical in some respects than conventional fleet moorings; and they need to be understood by those responsible for the hardware acquisition and installation.

Keywords: Mooring Systems, Buoys.

1.1 DM-26 FLEET-MOORINGS

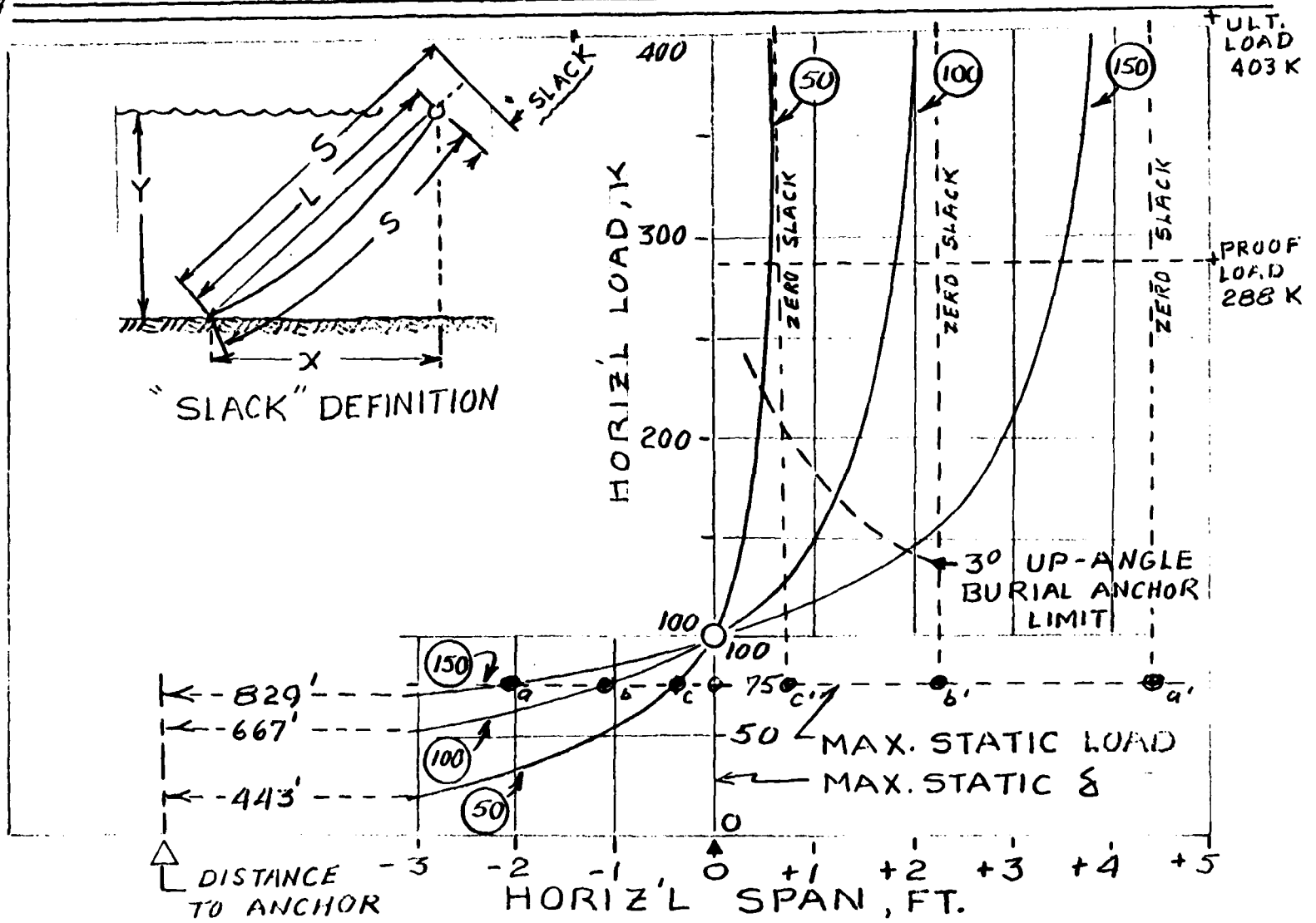
Figure 1 shows the operating characteristics catenary legs equivalent to those of a DM-26 CLASS C telephone-buoy type fleet mooring for 50 feet, 100 feet and 150 feet of water depth. CLASS C meets the Diego Garcia requirement of 100,000 pound horizontal load per leg. This load includes a factor of 1.33 for a dynamic load increment. The curves shown in Figure 1 are for a single leg of a free mooring (without sinkers).

The importance of Figure 1 is to show the critical aspects of shallow water moors compared to deeper water moors; and to show the magnitude of the horizontal span of the legs. The cross-over point of the three curves reflects a maximum dynamic loading criteria of 0° up-angle on the anchor shank, safety factor of 4: 1 and a "Slack" of 0.6 feet minimum. "Slack" is defined here as the excess of total catenary leg and riser length over a "tautline" length from the anchor to the buoy. Slack is therefore a measure of the mooring's capability to absorb oscillatory motion of the ship mooring bitt around its maximum static load excursion. From Figure 1 it can be seen that the spring rate (stiffness) of a shallow water mooring is greater than for the deeper water moorings. Also, the spring rates of moorings in the "working quadrant," or zone, are much less than for those in the "overload quandrant," or zone. This shows the necessity of avoiding working the overload zone where small ship motions develop high loads very rapidly. Also, in the "working zone," it can be seen that the higher spring rate of the shallow water moors tolerates substantially less ship oscillatory motion, for the same dynamic load factor, than is the case for the deeper water moors.

Although the Diego Garcia installation cannot accommodate the large horizontal span of the DM-26 fleet mooring design, the necessity for maintaining most of the design criteria and characteristics of the standard fleet moorings is recognized. This is particularly true with regard to providing at least the minimum chain "slack" criteria for the shallow water moor. Motion which cannot be accommodated by the chain must be absorbed by the elasticity of the ships breast lines to the buoy.

1.2 EMBEDMENT ANCHORS

Embedment anchors are required for permanent moorings in the coral seafloor at Diego Garcia; and CEL 100K lb. anchors have been installed and utilized there successfully for several years. The shallow water in conjunction



CHARACTERISTICS OF DM26 CLASS C MOOR

FIGURE 1

OCEAN FACILITIES ENGINEERING AND CONSTRUCTION PROJECT OFFICE

with limited horizontal span, involves high up-angles of the chain at the anchor-point as shown in Figure 2. The embedment anchor is not limited by the 3 degree up-angle limitation for burial anchors that is shown by Figure 1.

The high up-angles would have forced the system to work past the knee of the characteristic curve and up into the low-slack, chain snapping overload zone unless relatively large sinkers were used. Figure 3 shows the influence of sinker weight on slack for the final configuration. This accounts for the use of 20K pound anchors as sinker weights on the primary legs of the moorings.

Equally significant is the difference in failure mode between embedment anchors and burial anchors. The burial anchor may drag if overloaded but it may either dig in deeper, or it may rebury on future dragging. However, if the embedment anchor is overloaded, it starts to break-out of the soil and become less resistant to further overloading (if it does not break-out entirely). It cannot be depended on to recover such lost holding power. Thus, despite the established reliability and special merits of embedment anchors, they are less forgiving of design shortcomings and operational overloads than are burial anchor systems; and they can allow operation of chain and other components in a much less forgiving zone of the catenary load/defection curve.

Application of embedment anchors to this mooring design has reflected these design considerations in the emphasis placed on anchor load sharing provisions and tailoring the design to the bathymetry. In addition, methods for underwater measurement and adjustment of each leg assembly have been developed to assure load sharing balance and buoy location.

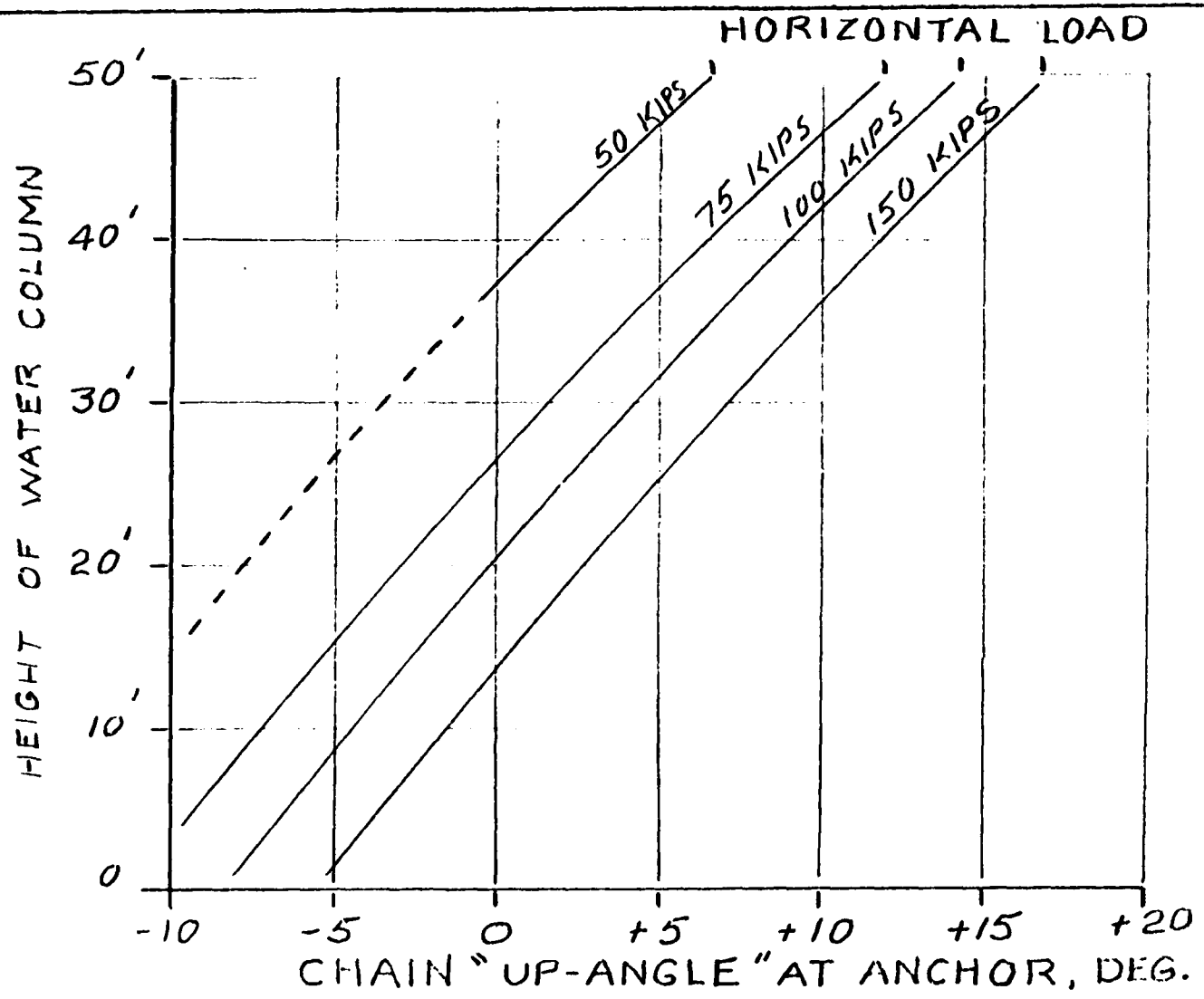
1.3 LEG SPAN AND ARRAY ANGLES

The horizontal span and the angular orientation of the legs of each mooring is determined by bathymetry, the proximity of the pier to the mooring buoys and by the location of the POL lines at the south end of the pier (as shown in Figure 4).

The embedment anchors, when used at the minimum thirty feet of water depth, require the use of the heavy-mass launcher for firing. As shown by Figure 4, the bathymetry is such that the horizontal span of the primary legs for the south array is limited to approximately 130 feet. The angular orientation to these 30-foot contour pockets, and clearance around the POL lines is also shown in Figure 4. The north mooring is made identical in scope of chain and component selection to the south mooring for the purpose of commonality.

1.4 MOORING LEG DESIGN CHARACTERISTICS

The characteristics of the final mooring leg design are shown in Figure 5. The maximum static load (75K lb.) and the maximum dynamic load with 1.33 factor (100K lb.) are shown to fall below the knee of the operating curve.



WATER DEPTH VS "UP ANGLE"
FIGURE 2

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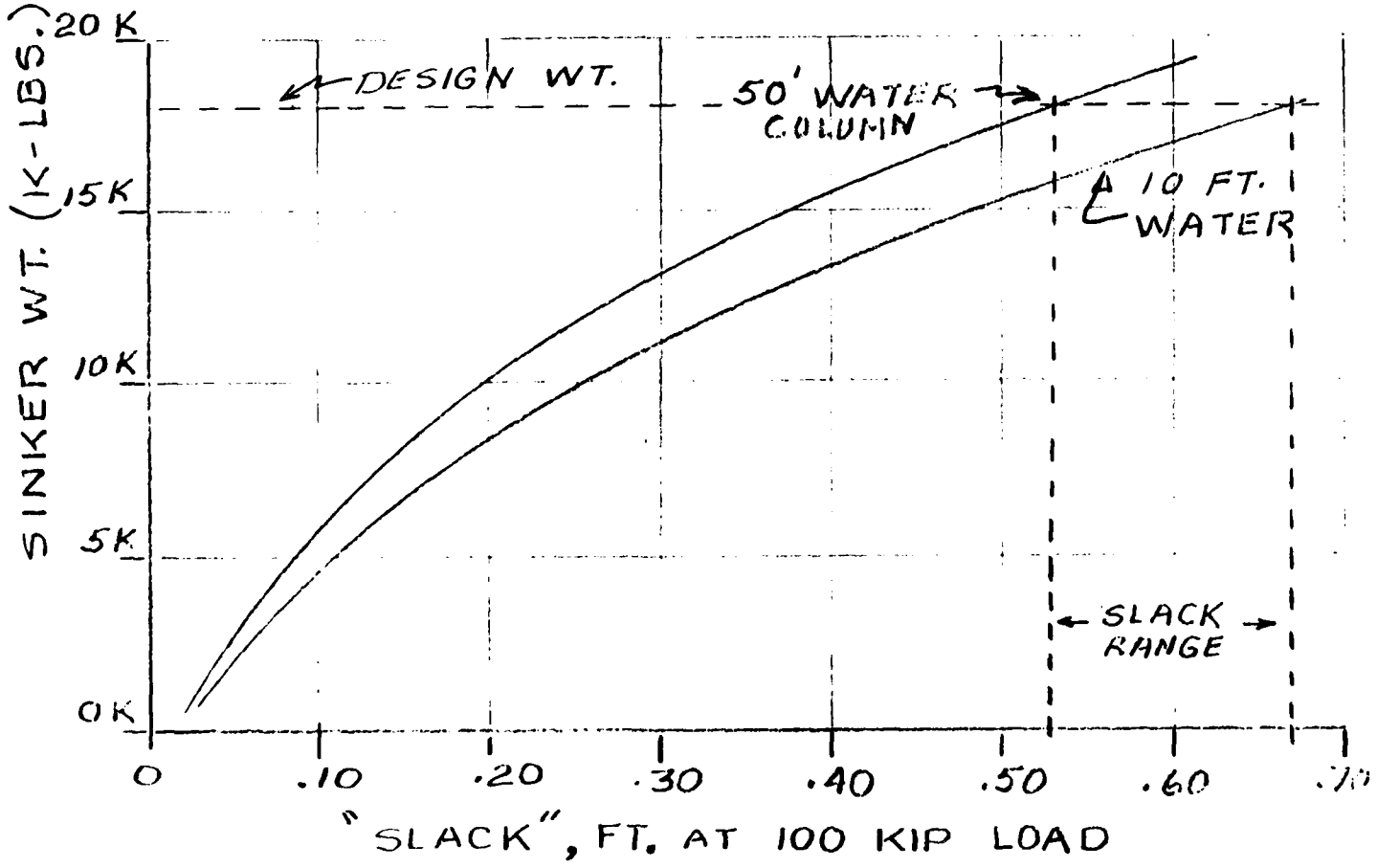

SINKER WEIGHT VS "SLACK"
FIGURE 3

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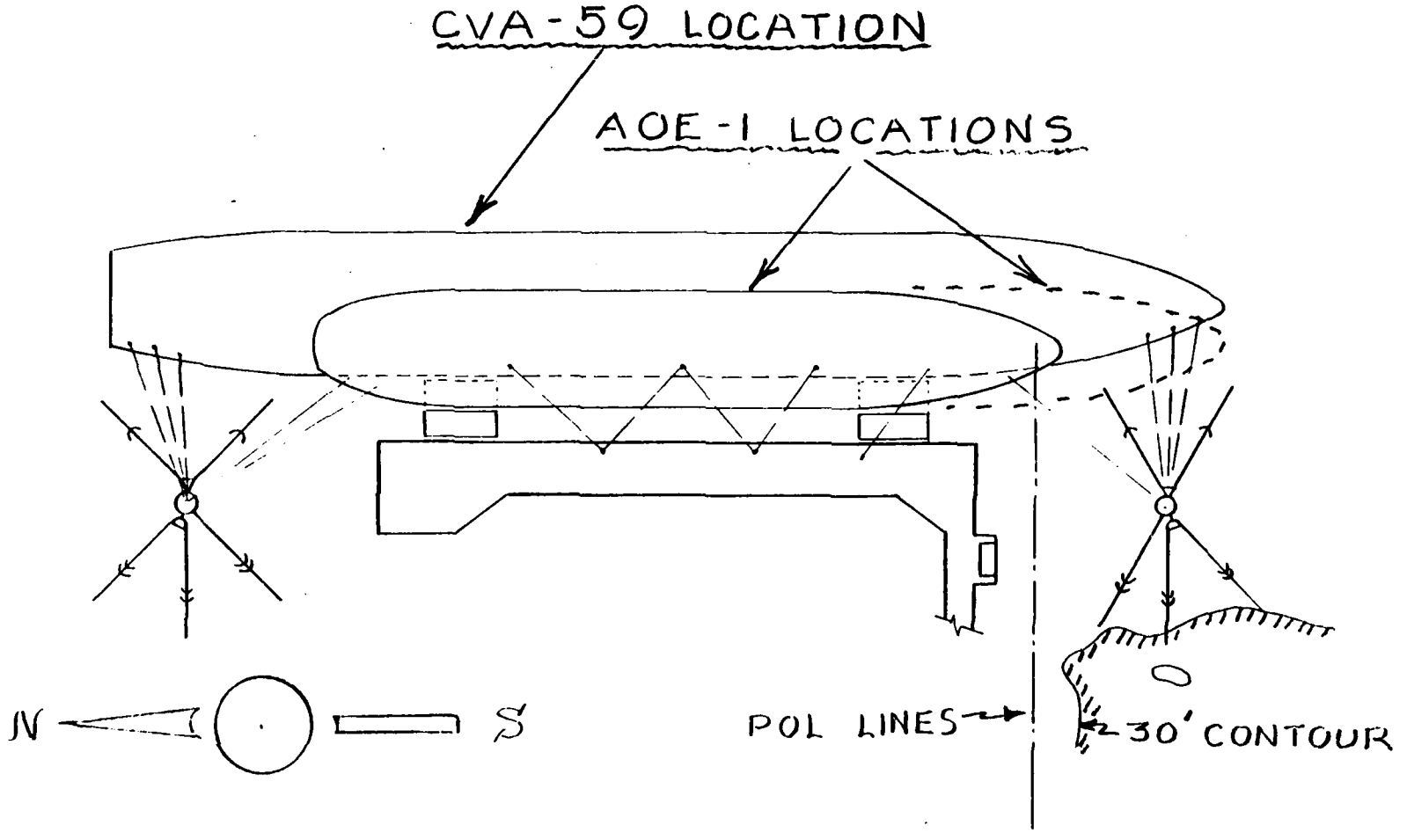

BUOY MOORING LAYOUT
FIGURE 4

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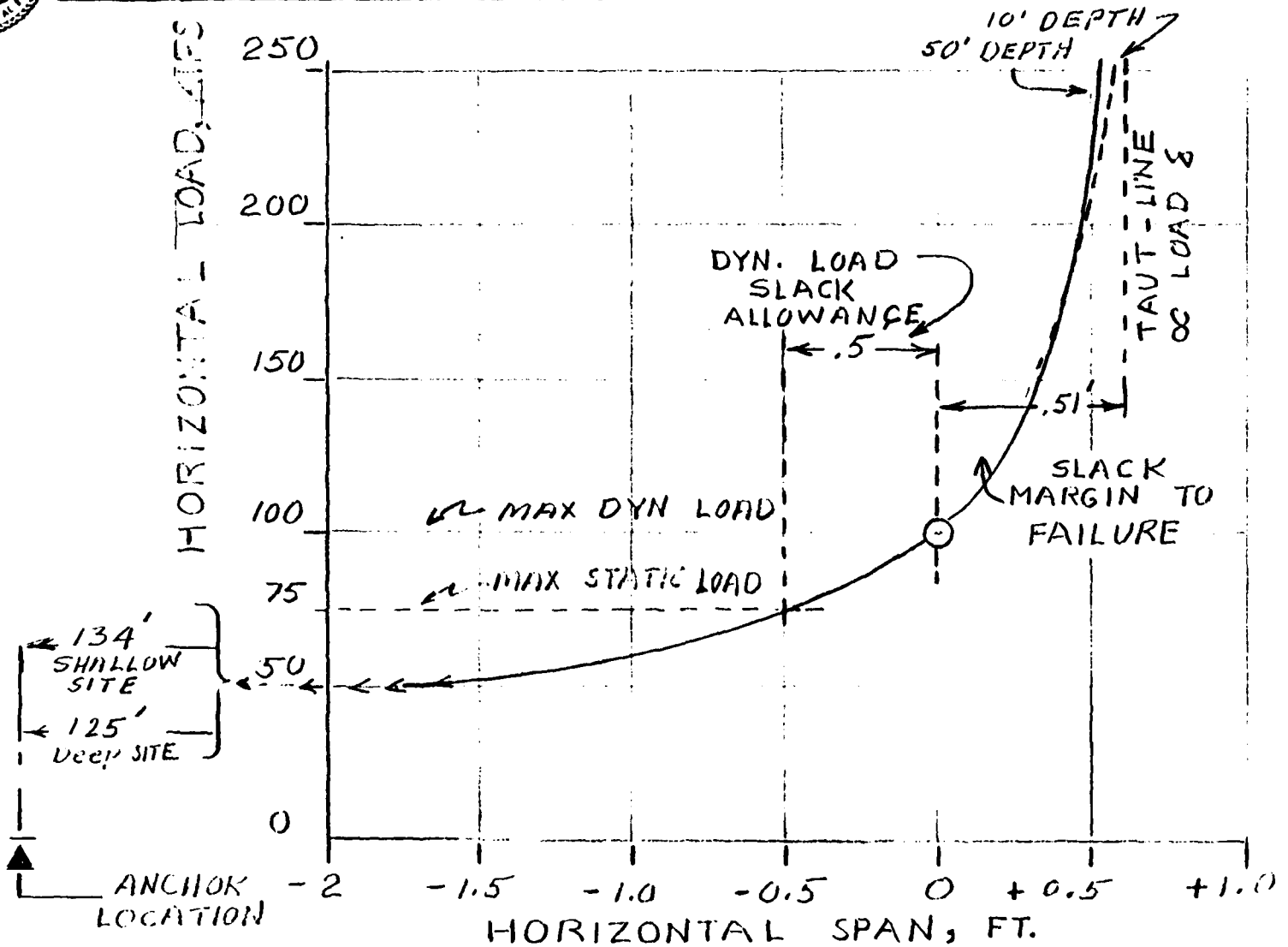

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MOORING LEG CHARACTERISTICS
FIGURE 5

The area between the 10-foot and the 50-foot water depth curves covers differences in bathymetry and tides. The sinker location meets the minimum slack criteria (0.5 feet) at maximum design static load; it maintains the free-buoy location, and it is within the free-buoy buoyancy capability to support the weight of the suspended chain-legs.

1.5 INSTALLATION LIFT-CONSTRAINTS

On-island lift equipment limitations (lack of suitable floating crane) have imposed special handling requirements.

The need to transfer on-shore hardware to a barge and then transport and place it on-bottom is met by transferring the heavier components on pallets from the pier to the seafloor using cranes on the pier. The barge then lifts the load off-bottom and transports it to the site while it is still suspended in the water. The lifting and lowering is accomplished with the bow sheave on the barge and a deck winch.

The need to lift the mooring ground ring and chain legs for hook-up to the buoy is accomplished by flooding and sinking the buoy down a guide-line attached to the ground ring. The keeper plate on the buoy is assembled to the riser chain; and the buoy is blown free of water to raise the buoy and the suspended mooring chain to the surface.

These operations require palletizing of certain leg sub-assemblies and subsequent lowering to the seafloor. The sink-and-float capability requirement for the buoys requires on-site foaming kits and modification of the peg-top buoys. The flood-and-blow operations require buoy modifications, air compressors and hoses and underwater hook-ups by the UCT-2.

2.0 INSTALLATION PLAN SUMMARY AND SCHEDULE

2.1 INSTALLATION PLAN SUMMARY

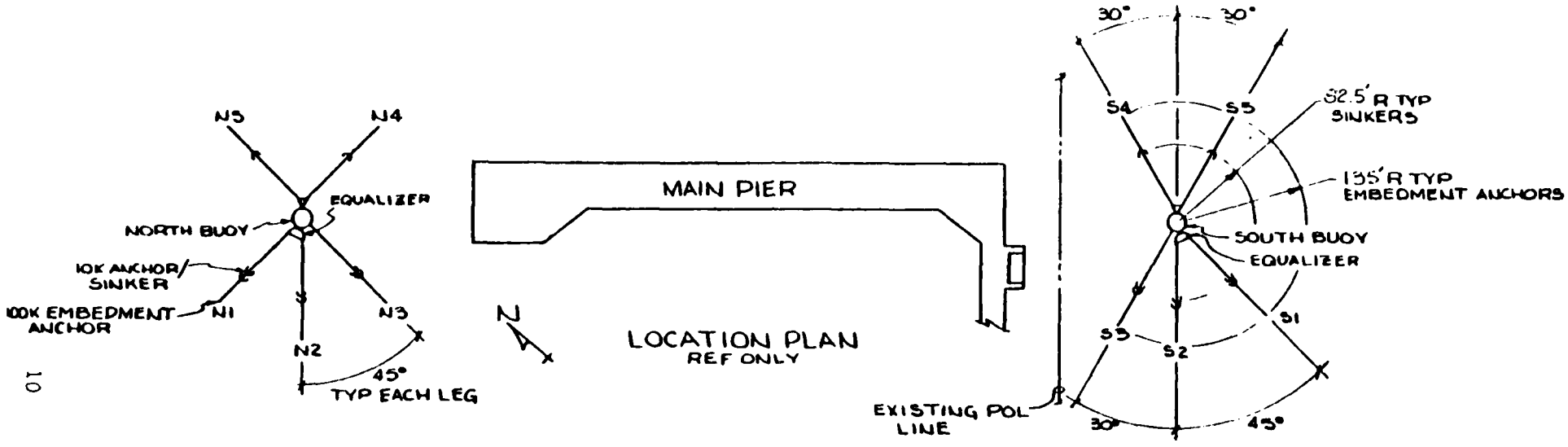
1. Preassemble CONUS components
2. Barge Preparation prior to UCT arrival on Diego Garcia
3. Mobilize construction barge for ops
4. Survey and place all marker buoys
5. Place 10-100K embedment anchors and pull test
   - (place 7-20K anchors as part of mooring maintenance, see appendix A for operations plan.)
6. Bring pallets to pier and offload to seafloor
7. Pick up pallet with barge lift wire, move to site, connect to embedment anchor wire - repeat for each leg of mooring
8. Connect legs of mooring to ground ring on bottom
9. Sink buoy to bottom and connect riser chain
10. Bring buoy to surface and complete buoy hardware assembly and cathodic protection attachment
11. Conduct mooring inspection including; survey location of buoys, photo and TV inspection,
12. Demobilize and prepare equipments for return shipments.

IMPORTANT NOTE

Reference Figure 6 and CHESNAVFAC Drawings 3017737, 3017738 (Rear Cover Jacket) for legend to mooring legs and component designators used throughout this manual.

2.2 SCHEDULE

Reference Figures 7 and 8.



LEGEND

EACH LEG IS NUMBERED 1 THROUGH 5. LEGS 1, 2, AND 3 ARE DESCRIBED AS "PRIMARY LEGS" WHILE LEGS 4 AND 5 ARE DESCRIBED AS "BACK STAY LEGS." EACH LEG IS ALSO IDENTIFIED AS NORTH OR SOUTH.

EXAMPLE: LEG NO. 2 AT THE SOUTH BUOY IS LEG S2.

FIGURE 6

PROJECT SCHEDULE

DIEGO GARCIA BUOY MOORING SYSTEM

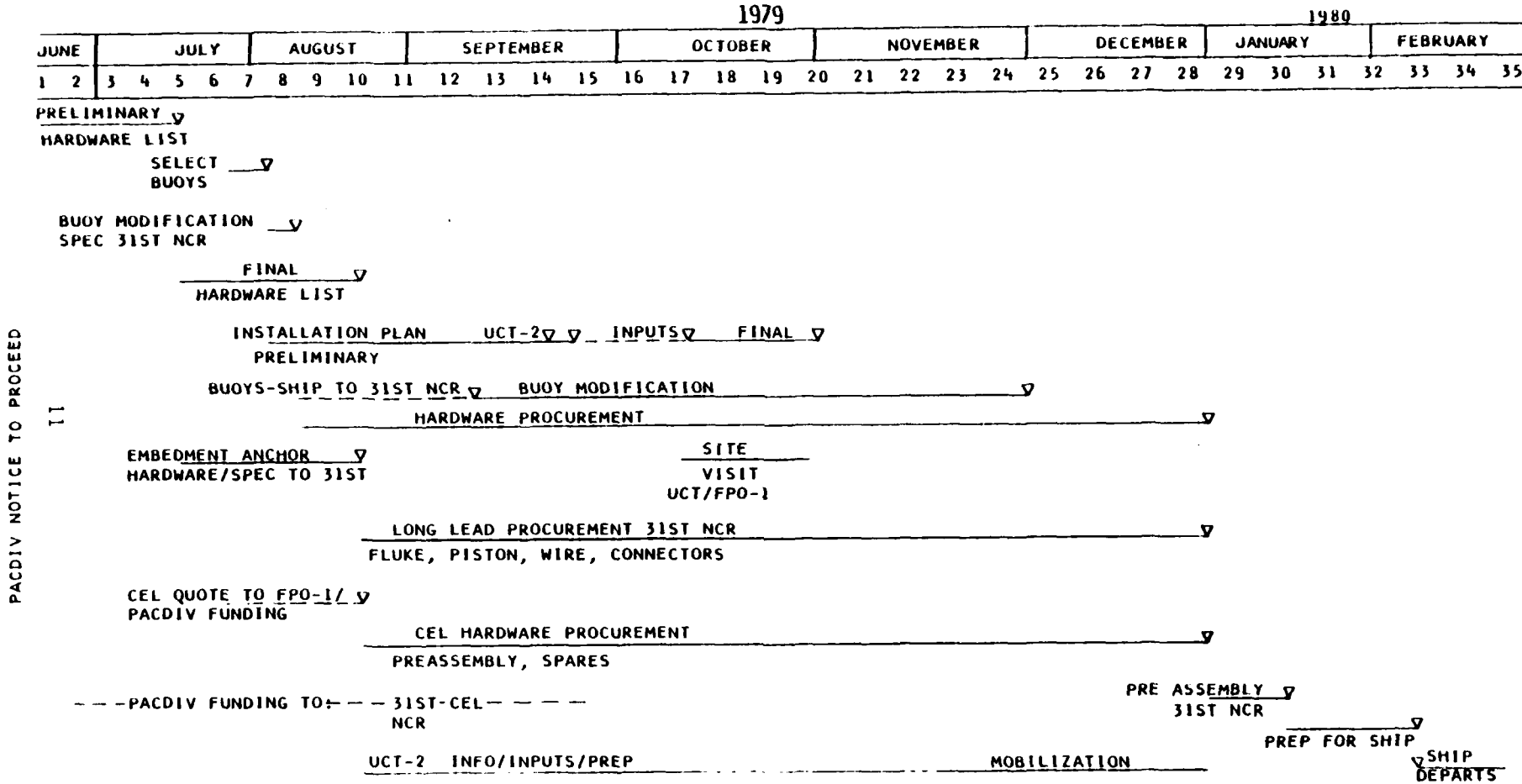


FIGURE 7

ON ISLAND

PROJECT SCHEDULE

DIEGO GARCIA BUOY MOORING

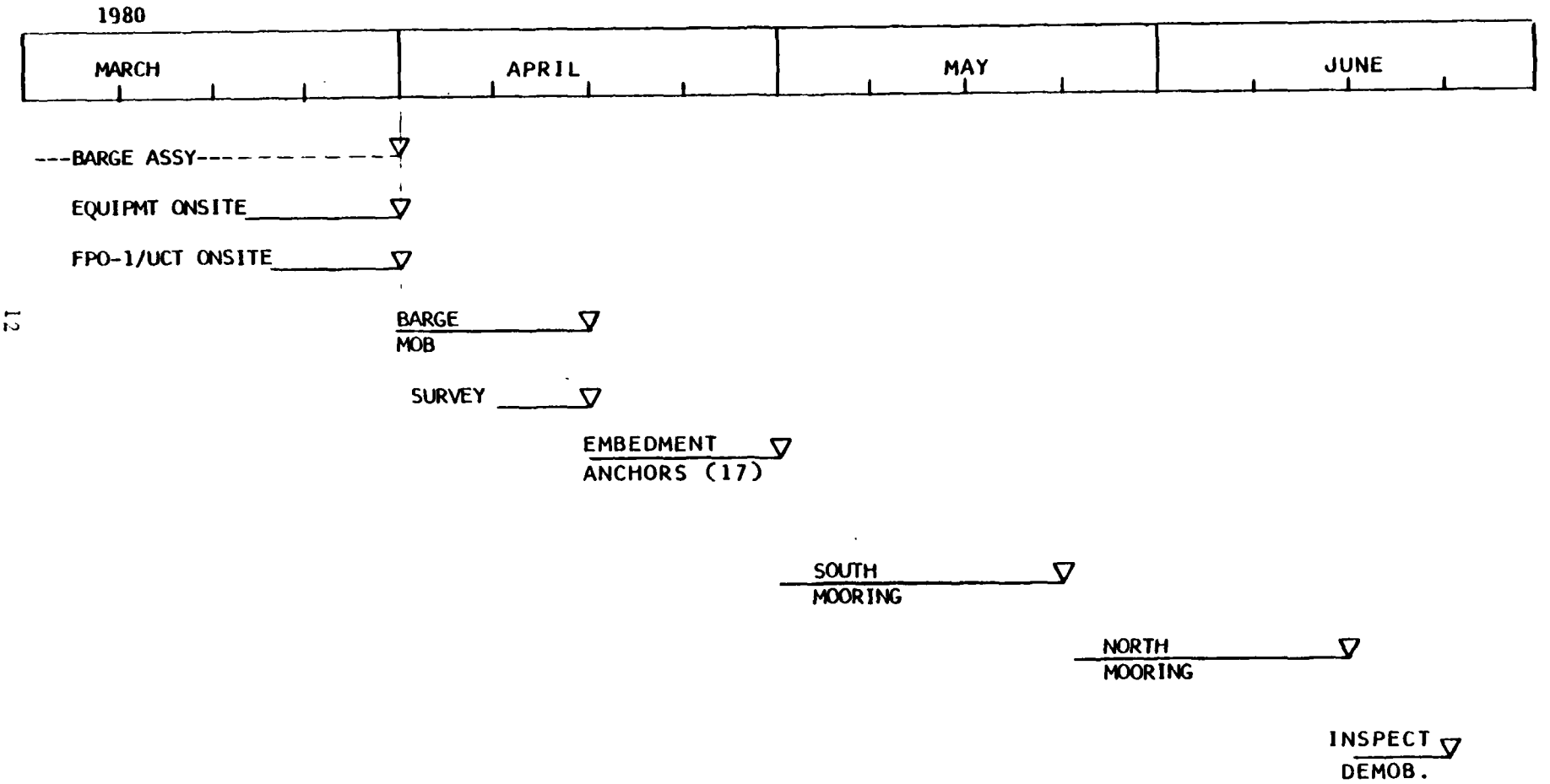


FIGURE 8

3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The organizational responsibilities for the design, mobilization, and execution of the installations are as delegated in the following paragraphs:

3.1 PACNAVFACENGCOM

3.1.1 Project Management

1. Task Assignment
2. Program Review
3. Financial support
4. Requirements and criteria

3.2 CHESNAVFACENGCOM (FPO-1)

1. Develop design, and installation plan tasks
2. Designate hardware requirements of mooring components
3. Provide survey/location requirement data
4. Provide hardware assembly drawing
5. Provide mobilization plan for preassembly at 31st NCR
6. Support technical support on site
7. Maintain master installation log (as-built)
8. Brief all hands at site on installation scenarios
9. Process photographic data
10. Provide cathodic protection plan and equipment requirements
11. Assume quality control responsibility of mooring installation in conjunction with UCT-2.
12. Assume responsibility for the component assembly and ordnance loading for firing of the embedment anchors
13. Provide UDATS system (TV) for final mooring inspection.

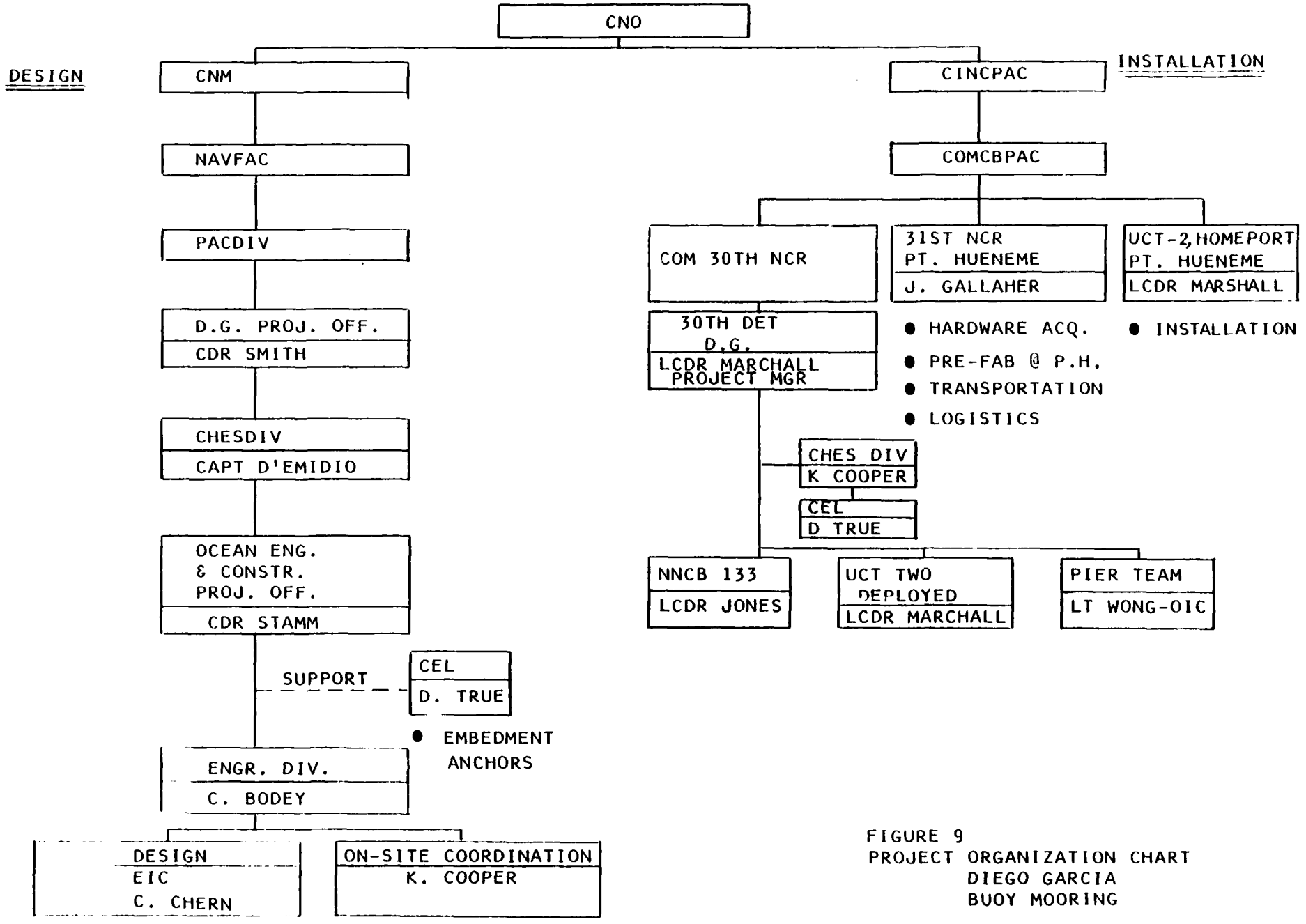


FIGURE 9
PROJECT ORGANIZATION CHART
DIEGO GARCIA
BUOY MOORING

3.3 31ST NCR

1. Provide components of mooring system

2. Direct transportation required to site

3. Provide load out and preassembly site (CONUS)

4. Modify components as required

5. Interface directly with PACDIV concerning financial responsibility of mooring components cost

6. Provide lift capability (30,000# max) to preassemble mooring components at 31st NCDR, and labor to preassemble and palletize components

7. Provide components to support operations as required by UCT-2 and CHESDIV

3.4 30 NCR DET DIEGO GARCIA

1. Provide working/storage area. Provide lift capability (10,000*) to be used during pallet assembly.

2. Provide YC barge work platform

3. Provide crane with operator for work platform

4. Prepared barge for operations by placing preassembled components on deck as per CHESDIV drawings and UCT-2 coordination

5. Provide double drum mooring winch (USN 8700605) and double drum pulling winch (USN 8700721), in operational condition without cable on drums

6. Provide on site berthing, messing

7. Provide LCM-6 with operator and deck crew

8. Provide message traffic on site

9. Maintain security on site

10. Provide crane operator

11. Provide transport from storage area to pier for preassembled components and off loading to seafloor alongside pier

12. Provide on site ordnance handling/storage

13. Maintain on island assets provided to support OPS

14. Provide 120 CFM/75PSI compressor and 200 ft. hose

15. Provide oxygen and MAPP gas

16. Direct materials from support ship to the assigned stagging area near the pier road and Air Ops. Maintain security of material

3.5 UCT-TWO

1. Implement installation plan

2. Have representative available at preassembly and palletizing of mooring components at 31st NCR

3. Plan/direct diving operation

4. Assemble valving on modified buoy for buoyance control

5. Assure safety responsibility for operations

6. Interface with on island support requirements

7. Provide diving equipment with communication

8. Provide hydraulic tools and power supply

9. Provide survey equipment and perform survey. Assume quality control responsibility of installation in conjunction with CHESNAVFACENGCOM (FPO-1).

10. Provide DC welding equipment and welders

11. Provide generator (110 VAC/2KW Min)

12. Conduct detailed dive inspection of mooring after installation

13. Provide 35mm underwater camera, take U/W photographs

14. Provide deck handling labor in support of embedment anchors

15. Maintain all UCT diving and associated equipment

16. Provide auxiliary support tools, welding, hydraulic com-a-longs, pry bars, rigging tools, tag lines

17. Provide meter to measure cathodic protection potential during final inspection

18. Maintain on site communication between barge, support craft and survey team

19. Provide barge security, ordnance security on barge

3.6 CIVIL ENGINEERING LABORATORY (CEL)

1. Provide consultation concerning use of embedment anchors

2. Provide on site representative to assist in anchor assembly

3. Document long lead items for procurement by 31st NCR (i.e., flukes, pistons, connectors, anchor wires)

4. Mobilize (CONUS) CHESDIV and SUPSAL embedment anchor guns (2)

5. Provide sheave suitable for use in pull test of 100K/lbs

6. Provide two load cells @ 150K lbs capacity

7. Provide preassembled embedment anchor installation equipment package

8. Provide slings to handle pistons

9. Provide anchor wire (2") containment box

10. Provide battery (24-32V) to fire SUPSAL embedment anchor

11. Provide all required equipment to 31st NCR for transportation per schedule

12. Assume quality control responsibility of embedment anchor components designated to 31st NCR for construction

13. Procure ordnance, package for transportation and storage, and coordinate transportation to site

4.0 MOORING HARDWARE MATERIALS LIST

The following hardware list is provided for reference only. See NAVFAC DRAWING 3017737 AND 2017738 (latest revision) for as built hardware list.

ITEM	QUANTITY REQUIRED	SPARES	TOTAL	LIST OF MATERIALS DESCRIPTION	IDENT.
1.	2	1	3	BUOY-MODIFIED PEGTOP	REF NAVFAC 1195707
2.	2	-	2	END LINK 3½"	FSN 2C4010-641-0005
3.	2	-	2	F SHACKLE	FSN 2C4030-640-9629
4.	10	1	11	ANCHOR JOINING LINK	FSN 2C4010-599-8928
5.	-	-	-	NOT USED	
6.	2	1	3	RUBBING CASTING 3½"	FSN KZ4030-640-9620
7.	16	2	18	ANCHOR JOINGING LINK 2¼"	FSN 2C4010-391-0534
8.	20	2	22	SWIVEL 2¼"	FSN 2C4030-527-8864
9.	24	4	28	JOINING LINK 2¼"	FSN 2C4010-391-U542
10.	2	1	3	JOINING LINK 3½"	FSN 2C4010-599-8927
11.	2	1	3	SHACKLE,ROUND PIN 3½"	BALT INC. OR EQUAL
12.	2	-	2	SPIDER PLATE	FSN 2C2040-695-2991
13.	2	-	2	GROUND RING	FSN 2C2040-527-0317
14.	12	2	14	ANCHOR JOINING LINK 2½"	FSN 2C4010-391-0535
15.	2	1	3	SHACKLE,ROUND PIN 2½"	BALT INC. OR EQUAL
16.	2	-	2	EQUALIZER	CIVENGLAB DWG 78-37-2F(2E1)
17.	24	24	48	ZINC ANODE, TYPE ZHC	MIL-A-18001
18.	20	2	22	SINKER SHACKLE	FSN 2C4030-267-7076
19.	10	-	10	ANCHOR WITH SHACKLE 20,000 LB MODIFIED BY NAVFAC DWG 3017738 WITH ANODES (2)	FSN H2040-368-4775

ITEM	QUANTITY REQUIRED	SPARES	TOTAL	LIST OF MATERIALS DESCRIPTION	IDENT.
20.	10	6	16	JOINING LINK 2½"	FSN 2C4010-391-0543
21.	10	-	10	PROPELLENT EMBEDMENT ANCHOR SYS.	REF NAVFAC MANUAL, 100K SYS.
22.	8	-	8	ANCHOR CHAIN-90' OF 2½"	FSN 2C4010-240-1030
23.	4	1	5	ANCHOR CHAIN-45' OF 2½"	FSN 2C4010-240-1038
24.	10	1	11	ANCHOR CHAIN-45' OF 2½"	FSN 2C4010-240-1039
25.	2	1	3	ANCHOR CHAIN-13' OF 3½"	FSN 2C4010-262-2588
26.	-	-	-	NOT USED	
27.	4	1	5	BOLT, 3/4" Ø X 16"	FSN G5306-174-9551
28.	4	2	6	NUT, 3/4"	FSN 5310-260-7900
29.	4	2	6	WASHER, 3/4" LOCKING	FSN 5310-013-8506
30.	-	-	-	NOT USED	
31.	172	8	180	CLAMP, NAVFAC 3017738-02	
32.	1350'	50'	1400'	WIRE ROPE, 3/4" DIA, GALVANIZED	
33.	100	10	110	WIRE ROPE CLIPS-3/4" WIRE	
34.	20	10	30	ANODE, 150 LB	HARCO P/N PZ150 OR EQUAL

5.0 CONUS PREASSEMBLY

Mooring components secured CONUS will be preassembled at 31st NCR to packaging for shipment. The purpose of the preassembly hardware layout is to:

1. Familiarize personnel with the components
2. Establish procedures for handling
3. Guarantee hardware interface
4. Package anchor pallets
5. Conduct inventory of mooring components and support hardware prior to shipment
6. Inspect modification of buoy and preassemble valves and hose connectors for buoyancy control
7. Locate, mark, and measure links to be used as corrosion standards
8. Secure zinc anodes to equalizers, add protective packaging.

5.1 PACKAGING OF MOORING LEGS ON PALLETS

Each mooring leg will be shipped from CONUS on an individual pallet as shown in Figure 10. The pallet will contain all hardware available CONUS at the time of assembly. Hardware shipped directly to Diego Garcia will be assembled onto the pallet at Diego Garcia.

5.1.1 Pallets: Wooden pallets will be constructed and delivered to the preassembly site. Each pallet is 20 feet long and 10 feet wide and is constructed of 6"x6" timbers. Each pallet will have an individual sling which will remain on the pallet for use during transport.

5.1.2 Pallet Packaging: Each mooring leg chain will be laid out and visually inspected prior to assembly.

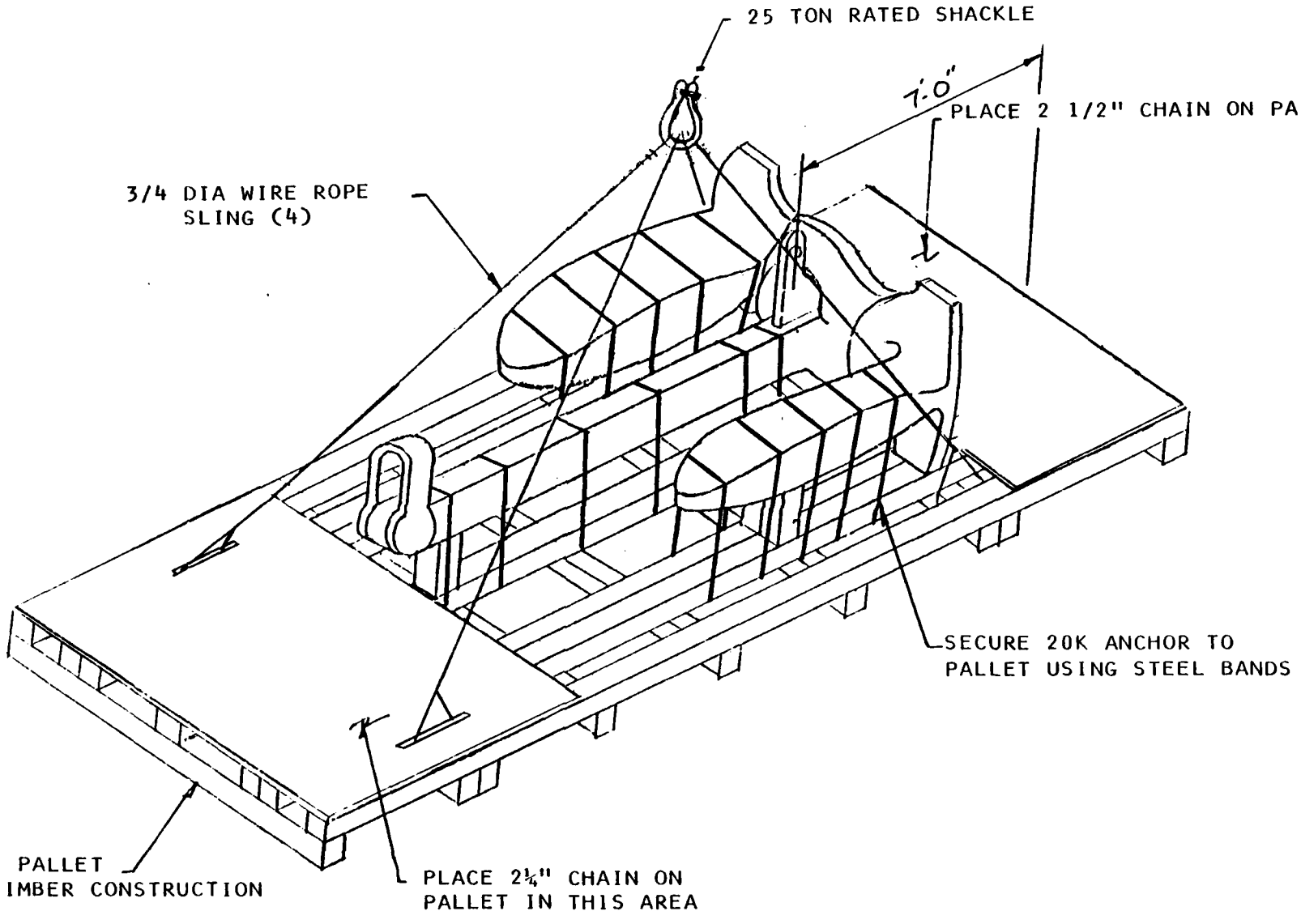


FIGURE 10
ANCHOR PALLET

5.2 PALLET ASSEMBLY

There will be one pallet for each mooring leg. Each pallet will be designated by the number (i.e., N1, N2,...) of the leg as shown on drawing 3017737.

5.2.2 Legs No. 1, 2 (Reference Figure 11)

1. Place 20,000# anchor on pallet. Place stanchion blocks under anchor as shown in figure .

2. Place steel bands around the anchor thus securing the anchor to the pallet

3. Connect hardware to chain as shown in Figure 11.

NOTE

2-1/4" chain may not be available at mobilization site. A quantity of 2-1/4" chain may be secured CONUS. All hardware should be assembled in place, however, no final assembly (i.e. forcing locating pins in place) of 2-1/4" chain connections should be made unless 2-1/4" chain is on location.

4. Lift the 2-1/2 in. chain over the centerline of the pallet. Lower the 2-1/2 in. chain and connect the chain to the anchor per the dimensions shown in Figure 11. Chain which is not on location will be assembled on Diego Garcia by this assembly process.

5. Beginning at the bitter end of the 2-1/2 in. chain, lay 3/4" diameter galvanized wire rope alongside the chain up to the area of the anchor anode.

6. Secure the end of the wire rope to the last 2-1/2 in. chain link using line.

7. Move up the 2-1/2 in. chain eight links and secure the cable to the chain using special clamps 3017738, item 31. Move up the chain four links and pass the cable through the chain. Continue to place clamps and pass the cable through the chain up to the area of the anchor. Reference figure 18 for cathodic protection detail.

8. Cut the cable to a length which will allow the cable to be secured to the anode having a wire facing the 2-1/2 in. chain. Secure the cable to the anode cable using three 3/4" wire clips.

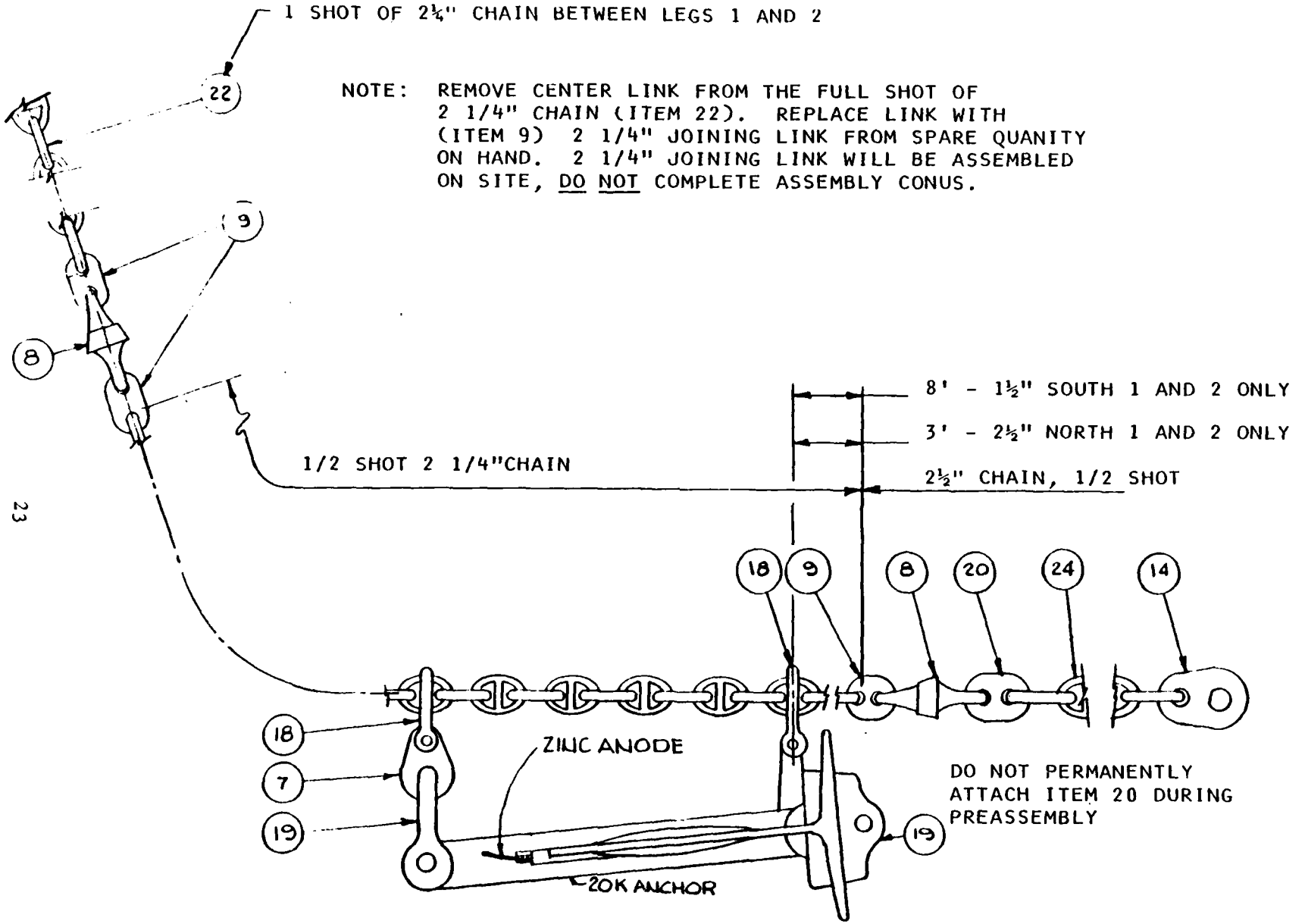


FIGURE 11
MOORING LEG
HARDWARE COMPONENTS
LEGS 1 AND 2

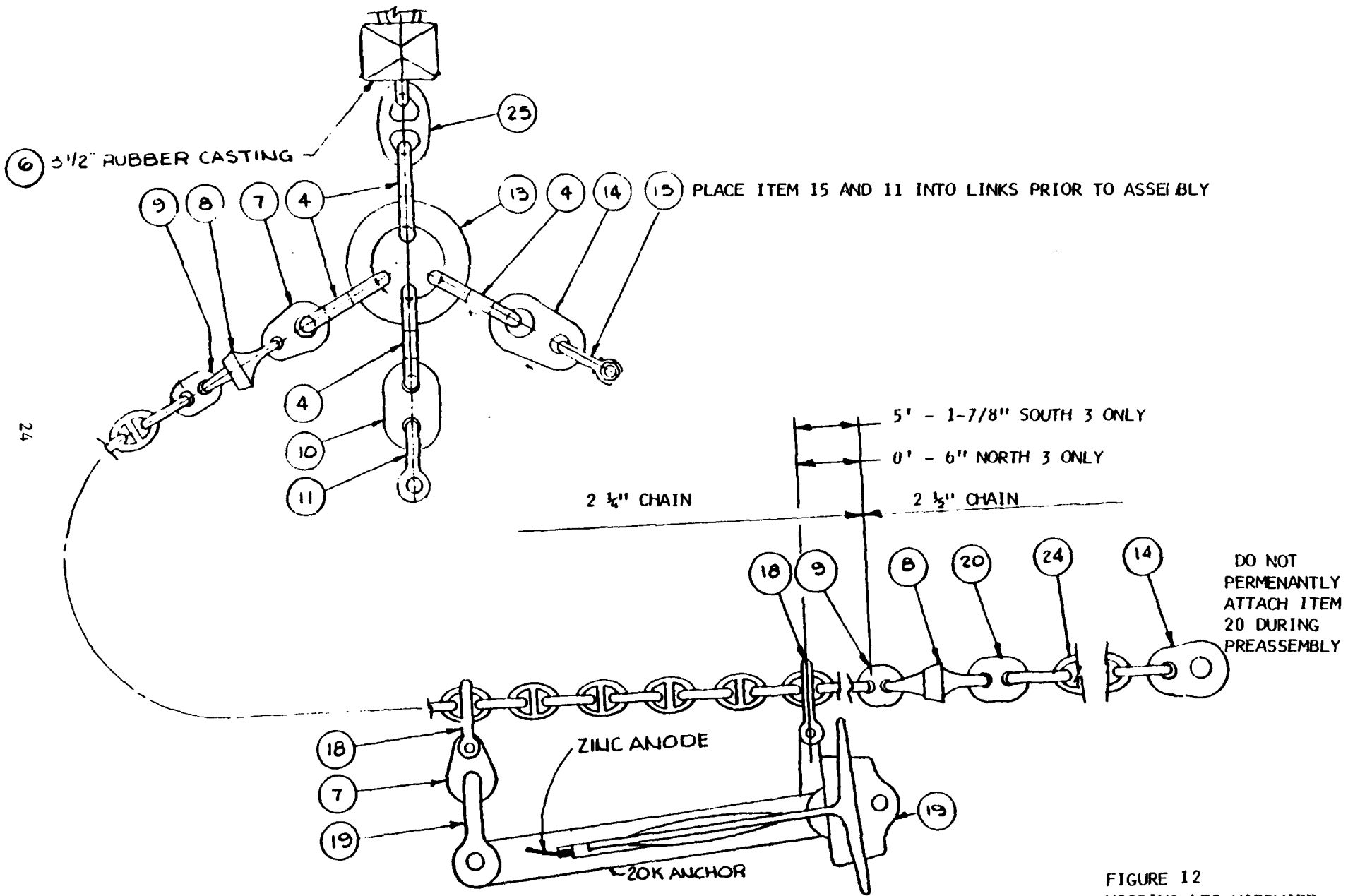


FIGURE 12
MOORING LEG HARDWARE COMPONENTS
LEG 3

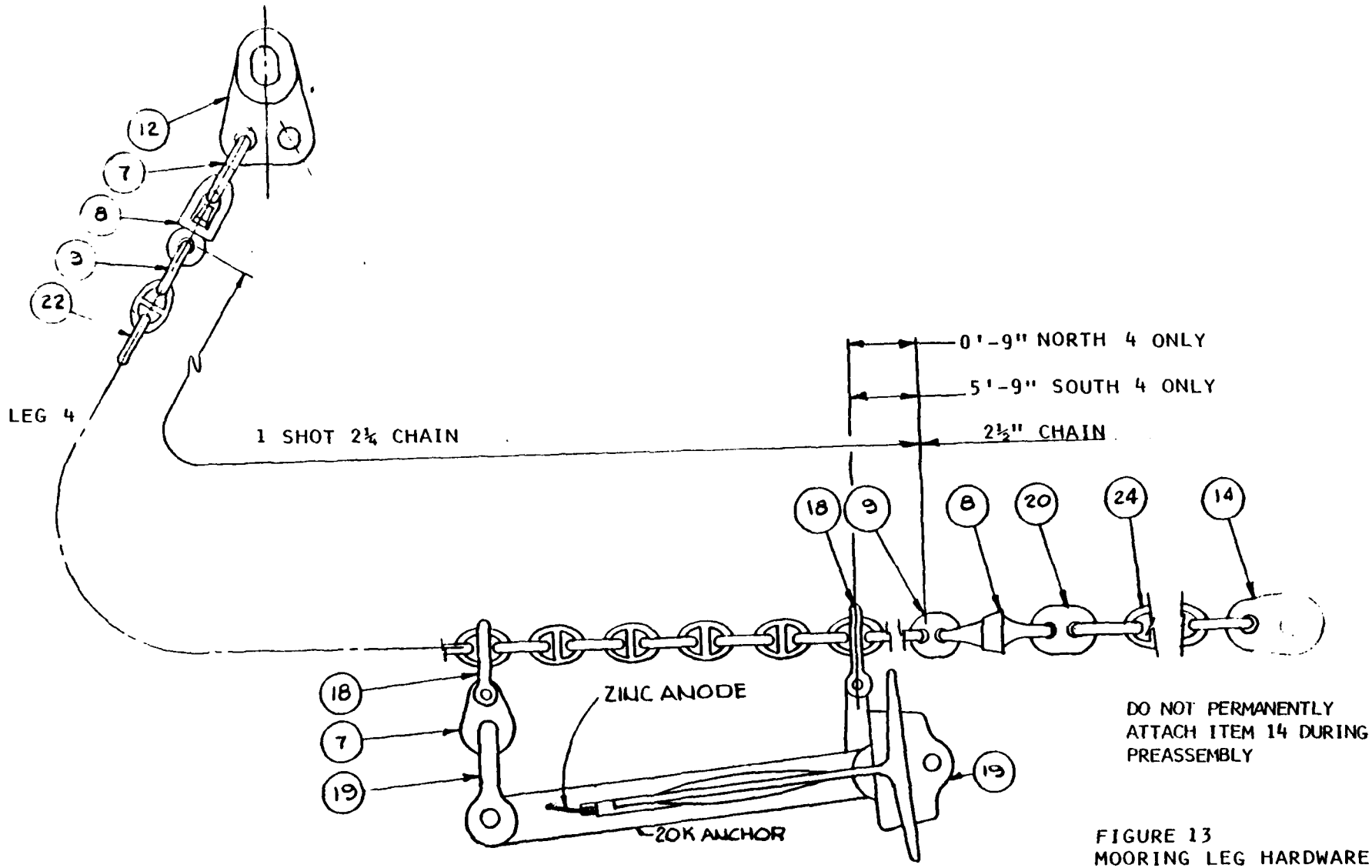


FIGURE 13
MOORING LEG HARDWARE COMPONENTS LEG NUMBER 4

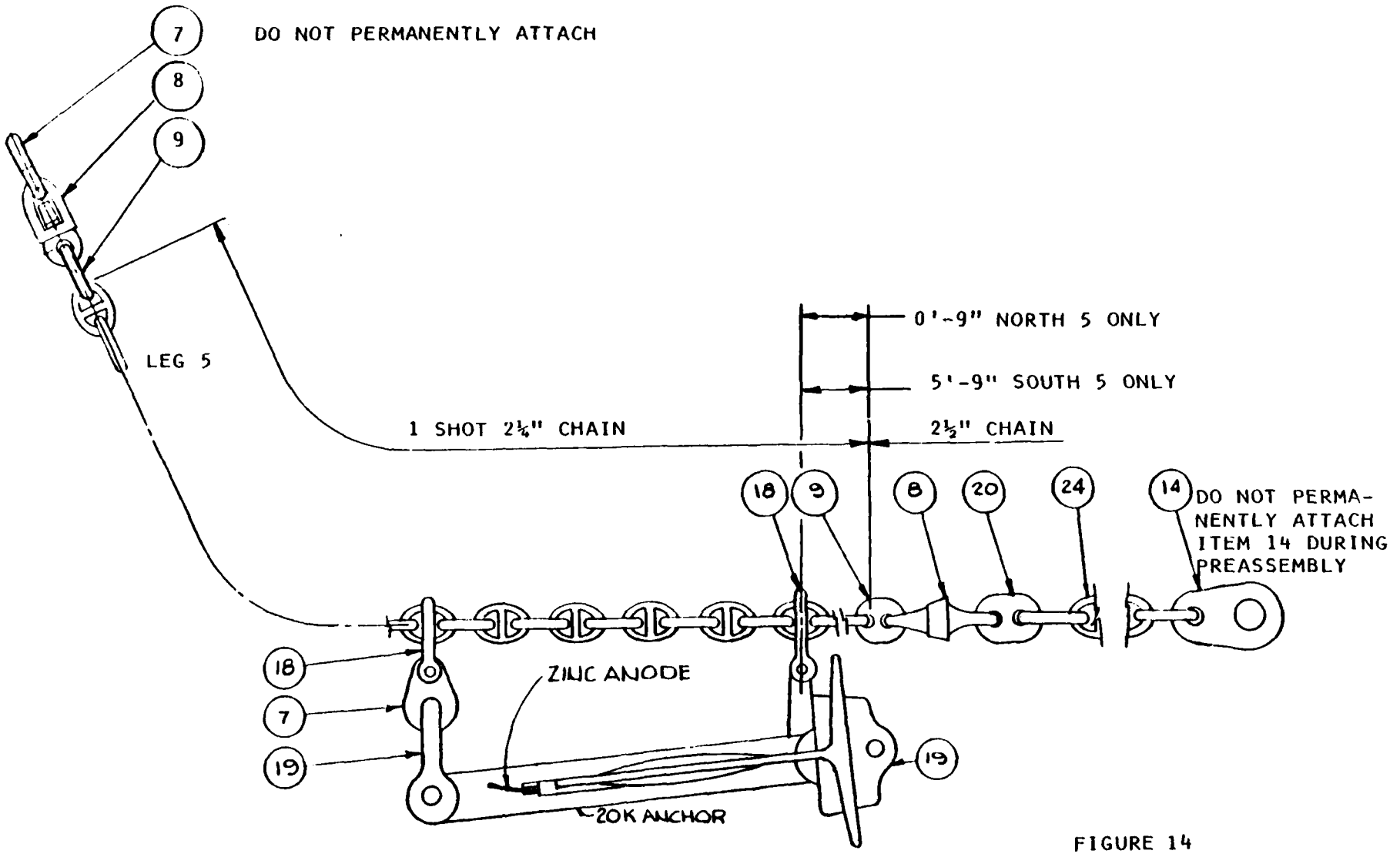


FIGURE 14
MOORING LEG HARDWARE
COMPONENTS
LEG NUMBER 5

9. Connect the 3/4" wire to the anchor anode facing the direction of the 2-1/4" chain using three 3/4" wire clips. Connect the cable to the chain, as described in 7 above, for a length of 75 feet.

10. Lift the bitter end of the 2-1/2" chain and place it on the pallet as shown in figure .

11. Flake the 2-1/4" chain, with the 3/4" wire rope attached, on the pallet

12. Secure the chain and plywood to the pallet using wire bands

13. Place a lifting bail under the pallet and secure in place

14. Clearly label the pallet with the leg number.

5.2.3 Leg No. 3: This pallet is assembled in the same manner as legs 1 and 2, and will contain all components shown in Figure 12.

5.2.4 Leg No. 4: This pallet is assembled in the same manner as legs 1 and 2 and will contain all components shown in Figure 13.

5.2.5 Leg No. 5: This pallet is assembled in the same manner as legs 1 and 2, and will contain all components shown in Figure 14.

5.3 MEASUREMENT OF COMPONENTS

In order to provide a future reference base for evaluation of corrosion data, measurements of components will be required prior to installation of the mooring. Each measurement will document a particular gauge to be compared to a new component standard and to future measurements taken during underwater inspections.

Each measurement shall be taken using measurement devices accurate to at least 1/32 inch. Each measurement will be taken after thoroughly cleaning the measurement area.

Document the measurement per the charts on the following pages. The measurements will become part of the master log and the "as-built" drawings.

DIEGO GARCIA BUOY MOORING PROJECT
MOORING COMPONENT DATA SHEET

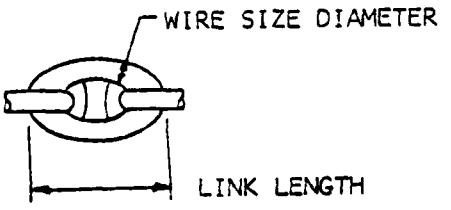
DATA BY_____ DATE_____

REFERENCE: NAVFAC DRAWINGS 3017737 AND 3017738

MOORING SITE: NORTH_____ SOUTH_____

LEG NO.	DWG IDENT ITEM NO.	NEW ITEM DIMENSION	FIELD DIMENSION	REMARKS
3	24	2½" DIA		1ST LINK 2½ AT ITEM 20
3	24	2½" DIA		10 LINKS FROM ABOVE
3	24	2½" DIA		10 LINKS FROM ABOVE
3	22	2¼" DIA		1ST 2¼ LINK NEAR ANCHOR
3	22	2¼" DIA		CENTER 2¼ LINK IN ½ SHOT
3	22	2¼" DIA		LAST 2¼ LINK IN ½ SHOT
3	22	2¼" DIA		1ST 2¼ LINK AT ITEM 9
3	22	2¼" DIA		15 LINKS FROM ABOVE
3	21			SWAGED SHANK DIAMETER
3	21	2"		WIRE DIA 3' FROM FITTING
3	4	6½" DIA		WIRE DIA OF GROUND RING
3	4			I.D. OF GROUND RING
3	25	3½" DIA		1ST LINK ABOVE GROUND RING
3	11	3-3/4"DIA		SHACKLE PIN DIA
3	15	2-3/4"DIA		SHACKLE PIN DIA

COMMENTS



RETURN DATA SHEET TO:
COMMANDING OFFICER, CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
BUILDING 57, WASHINGTON NAVY YARD
WASHINGTON, D.C., 20374
ATTN: CODE FPO1-C6

DIEGO GARCIA BUOY MOORING PROJECT
MOORING COMPONENT DATA SHEET

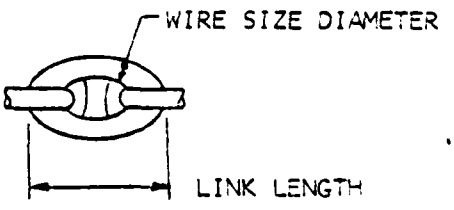
DATA BY_____ DATE_____

REFERENCE: NAVFAC DRAWINGS 3017737 AND 3017738

MOORING SITE: NORTH_____ SOUTH_____

LEG NO.	DWG IDENT ITEM NO.	NEW ITEM DIMENSION	FIELD DIMENSION	REMARKS
2	24	2½" DIA		1ST LINK 2½ AT ITEM 20
2	24	2½" DIA		10 LINKS FROM ABOVE
2	24	2½" DIA		10 LINKS FROM ABOVE
2	22	2¼" DIA		1ST 2¼ LINK NEAR ANCHOR
2	22	2¼" DIA		CENTER 2¼ LINK IN ½ SHOT
2	22	2¼" DIA		LAST 2¼ LINK IN ½ SHOT
2	22	2¼" DIA		1ST 2¼ LINK AT ITEM 9
2	22	2¼" DIA		15 LINKS FROM ABOVE
2	21			SWAGED SHANK DIAMETER
2	21	2"		WIRE DIA 3' FROM FITTING
2	16	1" PLT		SIDE PLATE THICKNESS
2	16	1" PLT		SIDE PLATE THICKNESS
2	16	1" PLT		EQUALIZIER CONNECTION PLT.
2	16 (ZINC 1)			ZINC HGT AT CTR ABOVE PLT
2	(ZINC 2)			DITTO
2	(ZINC 3)			DITTO
2	(ZINC 4)			DITTO
2	(ZINC 5)			DITTO
2	(ZINC 6)			DITTO

COMMENTS



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ATTN: CODE FPO1-C6

DIEGO GARCIA BUOY MOORING PROJECT
MOORING COMPONENT DATA SHEET

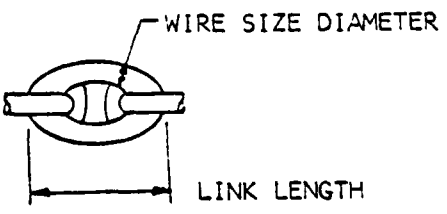
DATA BY_____ DATE_____

REFERENCE: NAVFAC DRAWINGS 3017737 AND 3017738

MOORING SITE: NORTH_____ SOUTH_____

LEG NO.	DWG IDENT ITEM NO.	NEW ITEM DIMENSION	FIELD DIMENSION	REMARKS
1	24	2½" DIA		1ST LINK 2½ AT ITEM 20
1	24	2½" DIA		10 LINKS FROM ABOVE
1	24	2½" DIA		10 LINKS FROM ABOVE
1	22	2⅛" DIA		1ST 2⅛ LINK NEAR ANCHOR
1	22	2⅛" DIA		CENTER 2⅛ LINK IN ½ SHOT
1	22	2⅛" DIA		LAST 2⅛ LINK IN ½ SHOT
1	22	2⅛" DIA		1ST 2⅛ LINK AT ITEM 9
1	22	2⅛" DIA		15 LINKS FROM ABOVE
1	21			SWAGED SHANK DIAMETER
1	21	2"		WIRE DIA 3' FROM FITTING

COMMENTS



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DIEGO GARCIA BUOY MOORING PROJECT
MOORING COMPONENT DATA SHEET

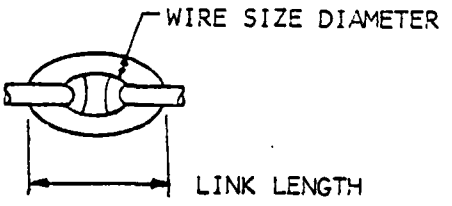
DATA BY_____ DATE_____

REFERENCE: NAVFAC DRAWINGS 3017737 AND 3017738

MOORING SITE: NORTH_____ SOUTH_____

LEG NO.	DWG IDENT ITEM NO.	NEW ITEM DIMENSION	FIELD DIMENSION	REMARKS
4	24	2½" DIA		1ST LINK 2½ AT ITEM 20
4	24	2½" DIA		10 LINKS FROM ABOVE
4	24	2½" DIA		10 LINKS FROM ABOVE
4	22	2⅛" DIA		1ST 2⅛ LINK NEAR ANCHOR
4	22	2⅛" DIA		CENTER 2⅛ LINK IN ½ SHOT
4	22	2⅛" DIA		LAST 2⅛ LINK IN ½ SHOT
4	22	2⅛" DIA		1ST 2⅛ LINK AT ITEM 9
4	22	2⅛" DIA		15 LINKS FROM ABOVE
4	21			SWAGED SHANK DIAMETER
4	21	2"		WIRE DIA 3' FROM FITTING
4	12	3"		PLATE THICKNESS

COMMENTS



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ATTN: CODE FPO1-C6

DIEGO GARCIA BUOY MOORING PROJECT
MOORING COMPONENT DATA SHEET

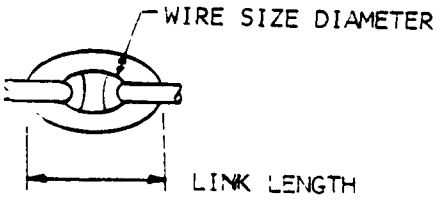
DATA BY_____ DATE_____

REFERENCE: NAVFAC DRAWINGS 3017737 AND 3017738

MOORING SITE: NORTH_____ SOUTH_____

LEG NO.	DWG IDENT ITEM NO.	NEW ITEM DIMENSION	FIELD DIMENSION	REMARKS
5	24	2½" DIA		1ST LINK 2½ AT ITEM 20
5	24	2½" DIA		10 LINKS FROM ABOVE
5	24	2½" DIA		10 LINKS FROM ABOVE
5	22	2¼" DIA		1ST 2¼ LINK NEAR ANCHOR
5	22	2¼" DIA		CENTER 2¼ LINK IN ½ SHOT
5	22	2¼" DIA		LAST 2¼ LINK IN ½ SHOT
5	22	2¼" DIA		1ST 2¼ LINK AT ITEM 9
5	22	2¼" DIA		15 LINKS FROM ABOVE
5	21			SWAGED SHANK DIAMETER
5	21	2"		WIRE DIA 3' FROM FITTING
---	---	---	---	---
---	6 (BUOY)			ZINC HGT AT CTR ABOVE PLATE
	6			DITTO
	6			DITTO
	6			DITTO

COMMENTS



RETURN DATA SHEET TO:
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NAVAL FACILITIES ENGINEERING COMMAND
BUILDING 57, WASHINGTON NAVY YARD
WASHINGTON, D.C., 20374
ATTN: CODE FPO1-C6

6.0 MOBILIZATION ON DIEGO GARCIA

Materials and equipment will be assembled on Diego Garcia in an area between Air Ops and the pier road.

6.1 Pallets - Materials shipped from locations other than CONUS will be inspected and assembled on to the proper pallet. Reference section 5.2. Each pallet will be completely assembled prior to being moved from the staging area.

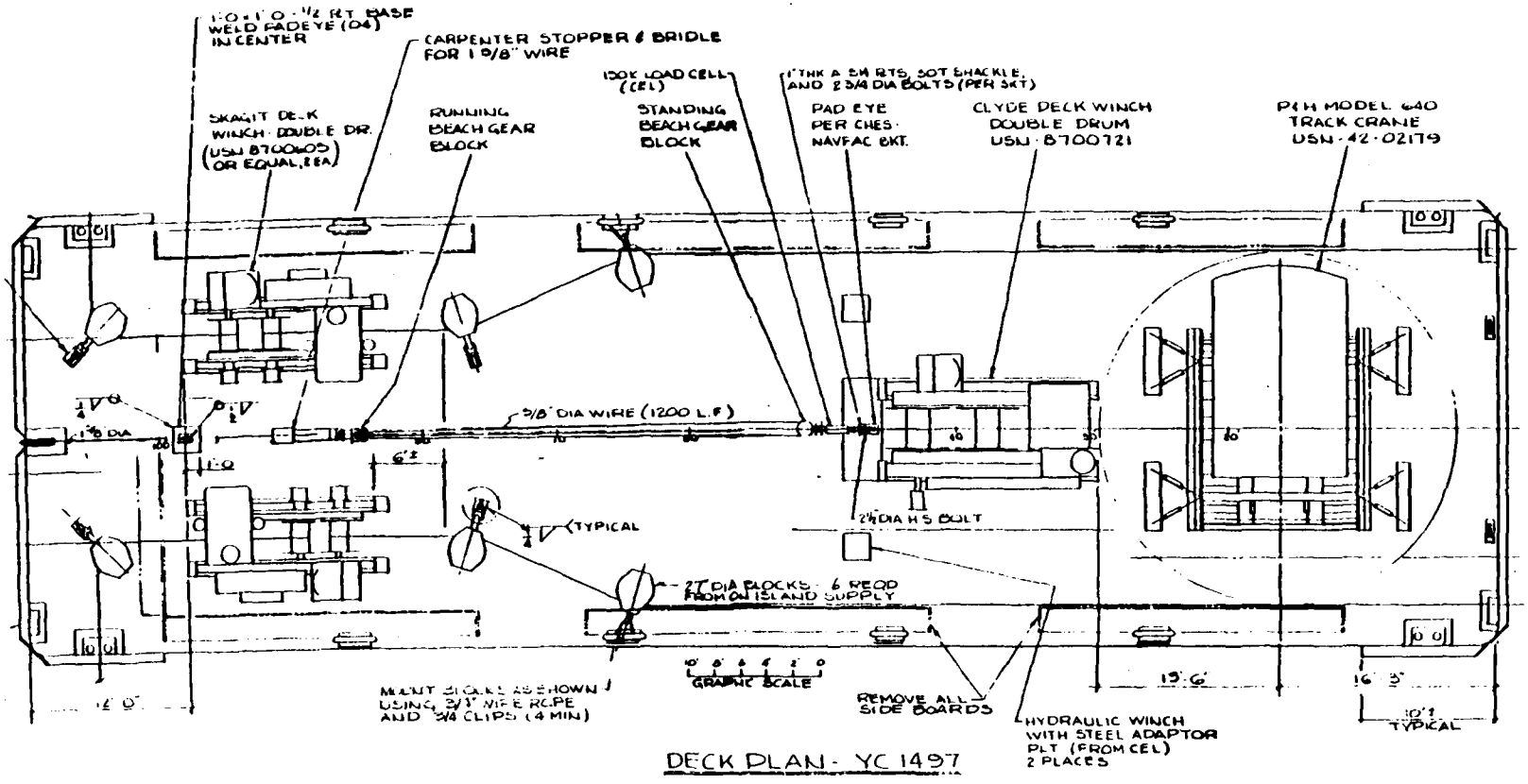
6.2 Barge Mobilization - The construction barge (YC 1497) will be set up per CHESNAVFAC Drawing 3017739 and 3017740 (Ref Figure 15). Major on island assets to be installed on the barge include:

a. Double drum mooring winch (Skagit), USN 8700605

b. Double drum pulling winch (Clyde), USN 8700721

c. Tracked crane (P&H 640), USN 42-02179

A second double drum (Skagit) winch will be shipped with project equipment and is to be installed per drawings referenced above.



CONSTRUCTION BARGE DECK EQUIPMENT PLAN

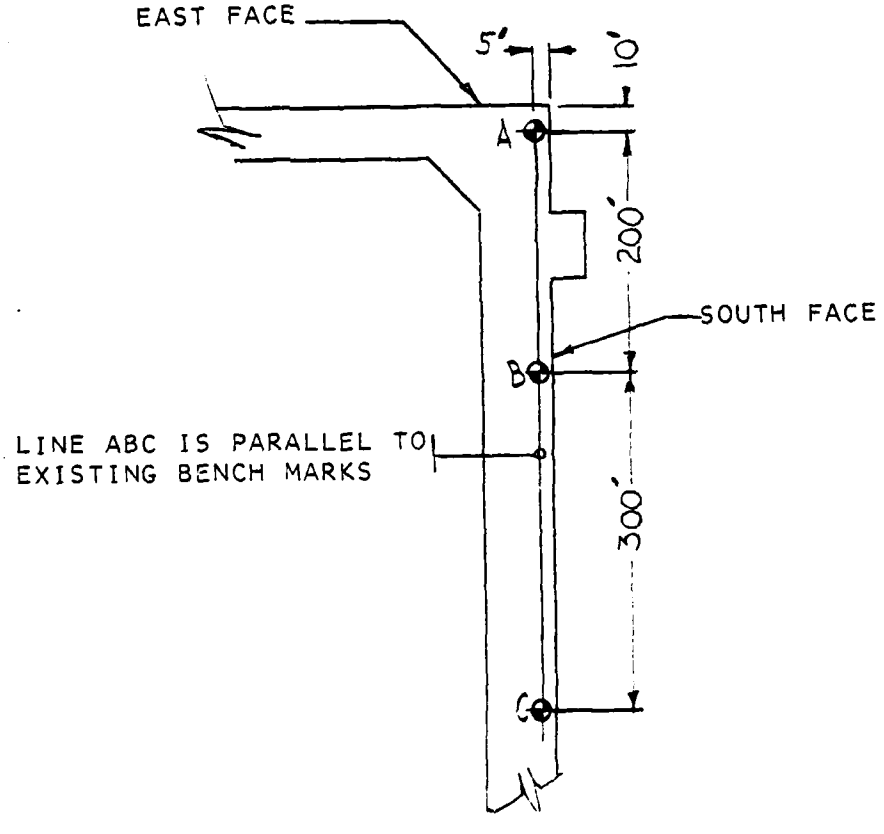
FIGURE 15

7.0 SURVEY

The survey is used to establish bearings to stations for the location of the mooring buoys, embedment anchors and sinkers. Section 7.1 establishes Station A, B, and C on approach trestle. Section 7.2 details bearings for south mooring buoy. Section 7.3 details bearins for north mooring buoy. Section 7.4 documents the procedure used for calculating bearings using station A, B, and C. Section 7.4 also provides a procedure for on site relocations of embedment anchors, sinkers, and/or construction mooring points.

7.1 ESTABLISHING STATIONS A, B, AND C

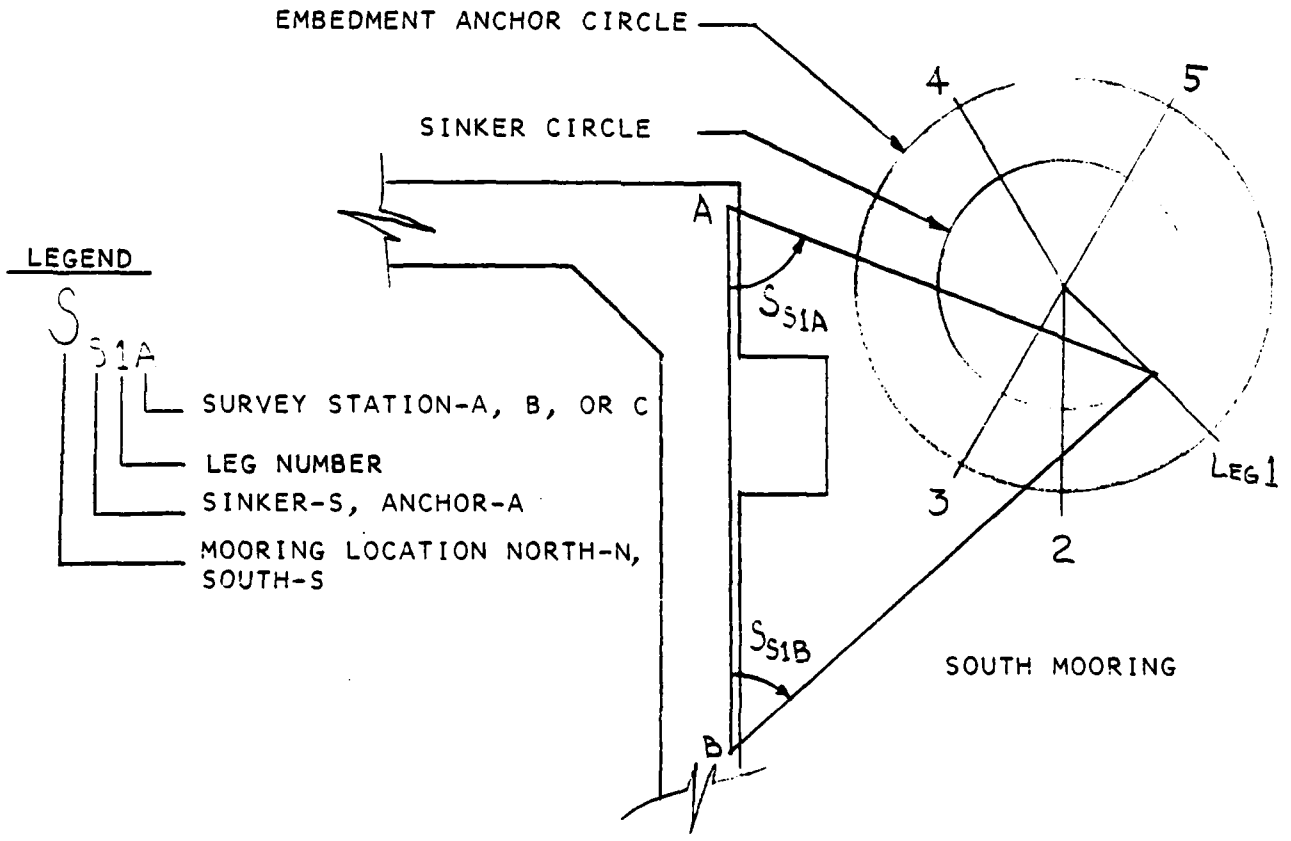
Stations A, B, and C are established on the approach trestle. Stations A, B, and C will be in a straight line and parallel to existing bench marks. Station A is set back 5 feet from south face of pier and set back 10 feet from east face of pier. Station B and Station C are 200 feet and 500 respectively from Station A.



7.2 SOUTH MOORING BUOY SURVEY

The south mooring buoy survey will use Station A and B for all survey points. The bearings from Station A will be read from line AB counterclock wise (CCW). The bearing from Station B will be read from line BA clockwise. An example is shown below.

Table 1 is a tabulation of all bearings for the legs of the south mooring buoy and for the construction mooring anchor locations.



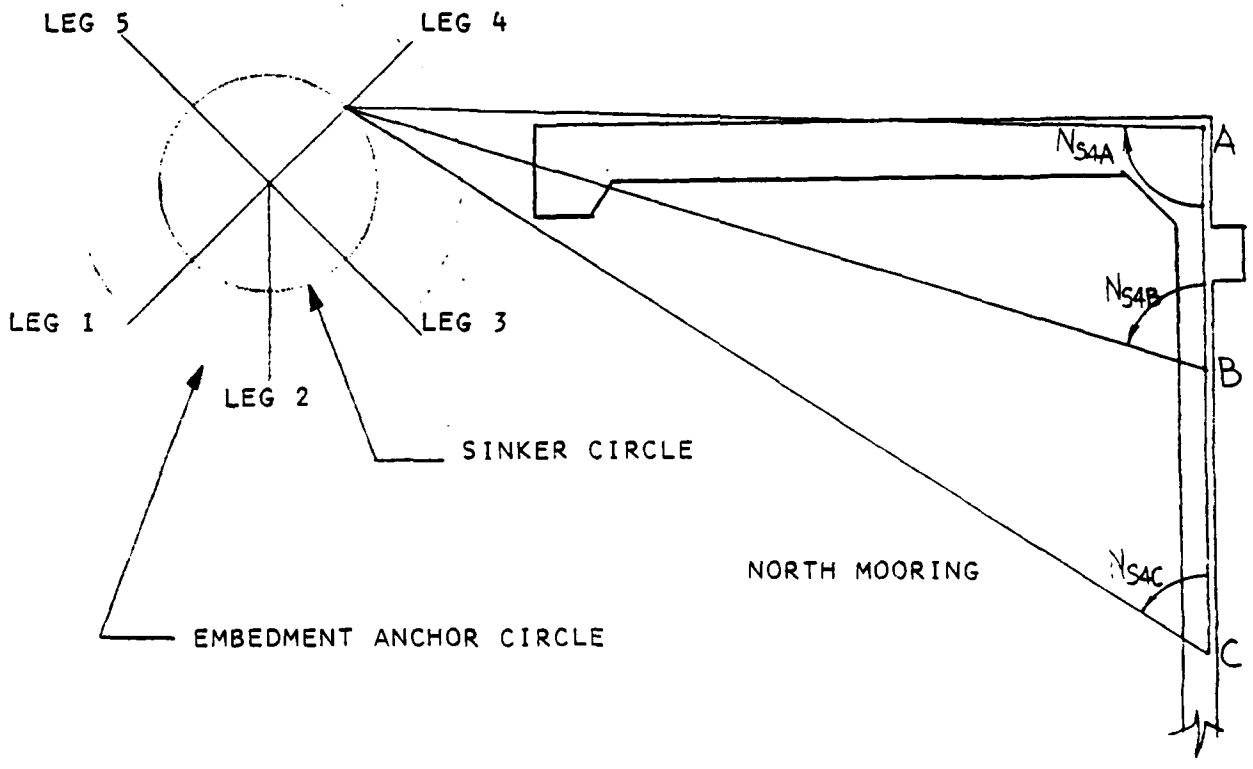
SOUTH MOORING BUOY
TABLE 1

STATION		A (READ CCW) ⊕	B (READ CW) ⊕
BUOY LOC.		74°28' 33.2"	50°11' 39.9"
S_{A1}		61°56' 39.5"	79°29' 13.6"
S_{A2}		43°35' 24.7"	86°31' 45.7"
S_{A3}		32°56' 41.5"	75°01' 21.8"
S_{A4}		122°31' 46.2"	22°12' 58.7"
S_{A5}		105°45' 54.9"	42°41' 50.9"
S_{S1}		65°01' 51.5"	70°22' 57.0"
S_{S2}		52°13' 27.5"	71°25' 19.0"
S_{S3}		46°41' 14.7"	61°48' 35.2"
S_{S4}		101°29' 48.8"	30°43' 50.5"
S_{S5}		96°58' 41.7"	44°39' 01.6"
CONSTRUCTION MOORING PT.	1	192°09' 38.5"	351°42' 34.6"
	2	120°34' 02.4"	46°34' 16.5"
	3	52°27' 12.7"	112°25' 23.1"

7.3 NORTH MOORING BUOY SURVEY

The north mooring buoy survey will use Stations A, B, and C to establish survey points for the legs of the mooring and for the construction mooring anchor. Shooting the bearings for the mooring buoy, embedment anchor, and sinker locations over the pier while under construction could lead to interference problems. Optional bearings are given in Table 2 to overcome this problem. The bearings for Station A are read from Line AB clockwise. The bearing for Station B are read from Line BA counterclockwise. The bearing for Station C are read from Line CB counterclockwise. An example is shown below.

Table 2 is a tabulation of multiple bearings from Stations A, B, and C for all legs of the north mooring buoy plus additional bearings for the construction mooring anchor locations.



NORTH MOORING BUOY
TABLE 2

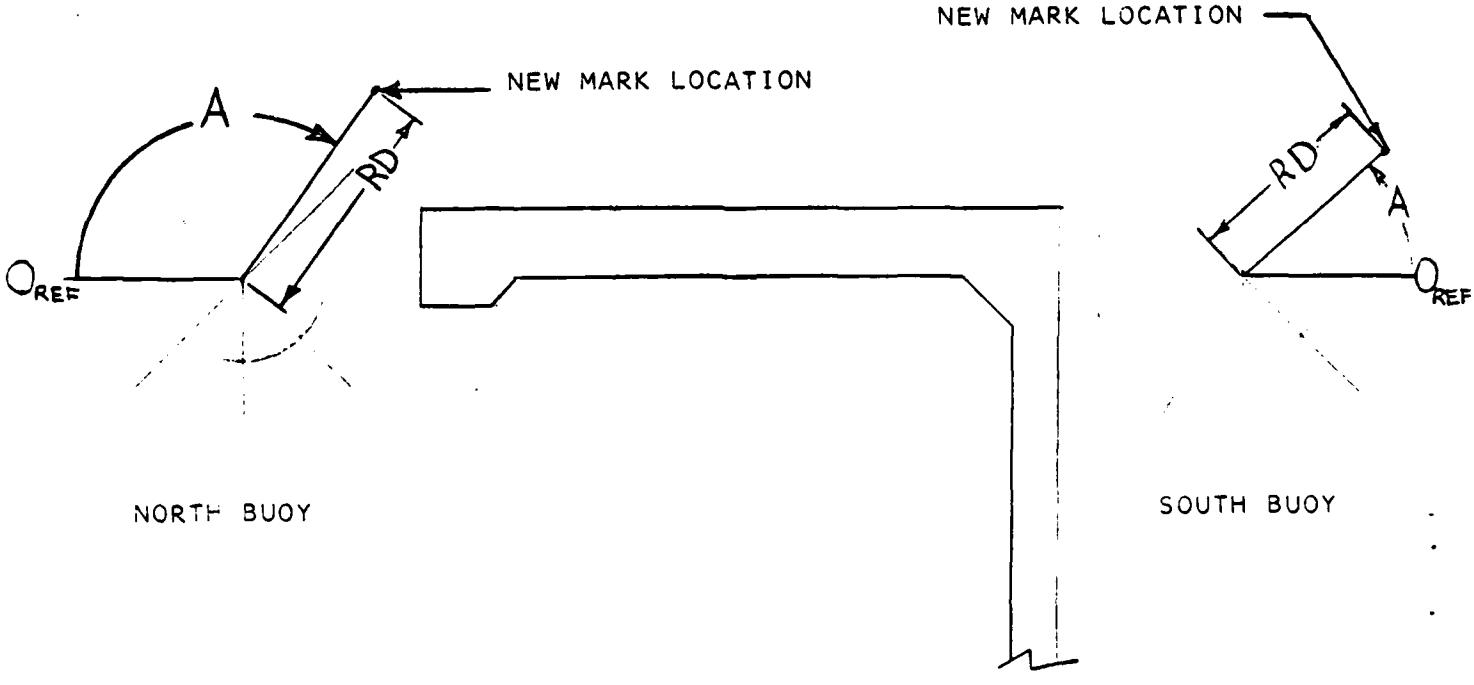
STATION		A (READ CW)	B (READ CCW)	C (READ CCW)
BUOY LOC.		80°01' 39.0"	78°13' 54.2"	* 57°59' 40.6"
N_{A1}		79°43' 30.8"	86°23' 18.0"	* 66°44' 46.4"
N_{A2}		75°17' 07.8"	89°07' 52.8"	* 66°38' 38.1"
N_{A3}		76°34' 42.1"	85°15' 00.7"	* 60°30' 15.4"
N_{A4}		94°26' 49.3"	* 68°13' 24.9"	48°35' 06.7"
N_{A5}		93°22' 51.7"	* 73°07' 06.0"	56°10' 31.0"
N_{S1}		81°46' 13.5"	83°40' 58.0"	* 63°43' 26.8"
N_{S2}		79°02' 05.3"	85°11' 48.6"	* 63°24' 11.3"
N_{S3}		80°12' 45.2"	82°28' 41.0"	* 59°30' 28.0"
N_{S4}		91°09' 32.4"	* 72°00' 26.5"	51°59' 20.0"
N_{S5}		90°58' 18.3"	* 74°46' 04.3"	56°45' 47.7"
CONSTRUCTION MOORING POINTS	1	68°35' 54.8"	101°52' 56.2"	86°27' 36.2"
	2	38°03' 49.3"	124°26' 01.7"	78°36' 13.6"
	3	134°27' 33.0"	32°26' 59.0"	22°07' 22.6"
	4	106°45' 38.1"	64°14' 03.2"	52°56' 55.8"

* OPTIONAL

7.4 NON-STANDARD SURVEY POINTS

This section is provided for use when a survey location required has been moved to a new distance radius or angle.

A hand-held calculator (TI 59-58) program is provided as part of this section to calculate new bearings. Information needed for new bearing is radial distance (RD) out from mooring buoy to new location and angle (A) from zero reference (explained below) to new location.



Mooring Survey Program uses TI 59-58 Labels A-E to index to proper mooring station (i.e., N_C,N_A, S_A...), Data, (RD, A) is entered into Data Storage memory 01, 02 respectively. RD and A have decimal equivalent in feet and degrees respectively for data entry format.

Resultant bearing has degrees, decimal point, minute, second and decimal equivalent seconds as a display format. Program sequence is as follows: Enter data (RD,A), press proper label, read display.

CAUTION

1. Enter data (RD,A) each time for proper display
2. Program works for bearing of 180° or less only, 180° must be added manually for bearings greater than 180°.

Label A - South Buoy Station A (S_A)

Label B - South Buoy Station B (S_A)

Label C - North Buoy Station A (N_A)

Label D - North Buoy Station B (N_B)

Label E - North Buoy Station C (N_C)

Display Format - DDD.MM SSS

TITLE DIEGO GARCIA BUOY LOCATIONS PAGE ____ OF ____

PROGRAMMER HUBLER DATE DEC/JAN 80

TI Programmable **Program Record**

Partitioning (Op 17) [ ] Library Module _____ Printer _____ Cards 1

PROGRAM DESCRIPTION

THIS PROGRAM DEFINES NON-STANDARD SURVEY LOCATIONS FOR THE POL PIER BUOY MOORING PROJECT, DIEGO GARCIA. THE USER IS REQUIRED TO DEFINE A DISTANCE RADIUS AND ANGLE FROM THE CENTER MOORING BUOY TO THE SURVEY POINT REQUIRED. THE PROGRAM WILL GIVE THE REQUIRED BEARING FROM ESTABLISHED STATIONS.

USER INSTRUCTIONS

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	ENTER RADIAL DISTANCE (RD) IN FEET INTO DATA STORAGE 01			
2	ENTER ANGLE (A) IN DEGREES INTO DATA STORAGE 02			
3	PRESS APPROPRIATE LABEL (A,B,C,D OR E) TO READ BEARING FROM STATION TO SURVEY POINT. DISPLAY FORMAT IS DD.MMSSS.			
	::::: THE FOLLOWING PAGES SHOW THE PROGRAM LISTING.			

USER DEFINED KEYS	DATA REGISTERS (INV)		LABELS (Op 08)
A SOUTH BUOY STA. A	0 ----	0	INV Ins CE CLR x⇄t x²
B SOUTH BUOY STA. B	1 RADIAL DISTANCE	1	√x 1/x STO RCL SUM y^x
C NORTH BUOY STA. A	2 ANGLE	2	EE ( ) ÷ GTO x
D NORTH BUOY STA. B.	3	3	SBR − RST + R/S ·
E NORTH BUOY STA C	4	4	+/- = CLR INV [illegible] [illegible]
A'	5	5	[illegible]
B'	6	6	[illegible]
C'	7	7	[illegible]
D'	8	8	[illegible]
E'	9	9	[illegible]

FLAGS	0	1	2	3	4	5	6	7	8	9

TITLE Disc Circle Mooring Buoy Survey PAGE 1 OF 2 TI Programmable

LOC	CODE	KEY	COMMENTS
000	76	LBL	South Buoy Station A
001	11	A	
002	00	0	Zero Test
003	32	X:T	
004	53	(	Register Index Ree
005	43	RCL	A to work
006	02	02	w/ this
007	94	+/-	Branch
008	85	+	Program
009	03	3	& Branch
010	06	6	A and Branch
011	00	0	B work w/
012	54	)	same A in
013	42	STO	02
014	02	02	
015	53	(	
016	53	(	Translates
017	01	1	coordinates
018	08	8	de mark
019	00	0	back to
020	85	+	station
021	53	(	
022	43	RCL	
023	01	01	
024	65	×	
025	53	(	
026	43	RCL	
027	02	02	
028	39	COS	
029	54	)	
030	54	)	
031	54	)	
032	55	÷	
033	53	(	
034	05	5	
035	00	0	
036	85	+	
037	53	(	
038	43	RCL	
039	01	01	
040	65	×	
041	53	(	
042	43	RCL	
043	02	02	
044	38	SIN	
045	54	)	
046	54	)	
047	54	)	
048	54	)	
049	32	INV	Tan^{-1}
050	39	TAN	
051	42	STO	
052	03	03	
053	22	INV	Decision if Neg &
054	77	GE	

LOC	CODE	KEY	COMMENTS
055	03	03	
056	00	00	
057	43	RCL	Changes Fiction to D.M.S
058	03	03	
059	22	INV	
060	88	DMS	
061	91	R/S	
062	00	0	
063	00	0	
064	00	0	
065	00	0	
066	76	LBL	South Buoy Station B
067	12	B	
068	00	0	
069	32	X:T	Same
070	53	(	Layout
071	53	(	as
072	01	1	South Buoy
073	08	8	Station A
074	00	0	
075	85	+	Distance from Station B to Buoy X-Direction
076	53	(	
077	43	RCL	
078	01	01	
079	65	×	
080	53	(	
081	43	RCL	
082	02	02	
083	39	COS	
084	54	)	
085	54	)	
086	54	)	
087	55	÷	
088	53	(	
089	01	1	
090	05	5	Distance from Station B to Buoy Y-Direction
091	00	0	
092	85	+	
093	53	(	
094	43	RCL	
095	01	01	
096	65	×	
097	53	(	
098	43	RCL	
099	02	02	
100	38	SIN	
101	54	)	
102	54	)	
103	54	)	
104	54	)	
105	32	INV	
106	39	TAN	
107	42	STO	
108	04	04	
109	22	INV	
110	77	GE	

LOC	CODE	KEY	COMMENTS
111	03	03	
112	00	00	
113	43	RCL	
114	03	03	
115	22	INV	
116	88	DMS	
117	91	R/S	
118	00	0	
119	00	0	
120	00	0	
121	00	0	
122	00	0	
123	76	LBL	North Buoy Station A
124	13	C	
125	00	0	
126	32	X:T	Same
127	43	RCL	Layout
128	02	02	as
129	94	+/-	South Buoy
130	42	STO	Station A
131	02	02	
132	53	(	
133	53	(	
134	07	7	
135	02	2	
136	00	0	
137	85	+	
138	53	(	
139	43	RCL	
140	01	01	
141	65	×	
142	53	(	
143	43	RCL	
144	02	02	
145	39	COS	
146	54	)	
147	54	)	
148	54	)	
149	55	÷	
150	53	(	
151	05	5	
152	00	0	
153	85	+	
154	53	(	
155	43	RCL	
156	01	01	
157	65	×	
158	53	(	
159	43	RCL	

INVERTED CODES

62		72		83	
63		73		84	
64		74		92	

LOC	CODE	KEY	COMMENTS
150	02	02	
151	38	SIN	
152	54	)	
153	54	)	
154	54	)	
155	54	)	
156	22	INV	
157	30	TAN	
158	42	STO	
159	03	03	
160	22	INV	
161	77	GE	
162	03	03	
163	00	00	
164	43	RCL	
165	03	03	
166	22	INV	
167	88	DMS	
168	91	R/S	
169	00	0	
170	00	0	
171	00	0	
172	76	LBL	North Buoy Station B
173	14	D	
174	00	0	
175	32	X:T	Same Layout As South Buoy Station A
176	53	(	
177	53	(	
178	07	7	
179	02	2	
180	00	0	
181	85	+	
182	53	(	
183	43	RCL	
184	01	01	
185	65	×	
186	53	(	
187	43	RCL	
188	02	02	
189	39	COS	
190	54	)	
191	54	)	
192	54	)	
193	55	÷	
194	53	(	
195	01	1	
196	05	5	
197	00	0	
198	85	+	
199	53	(	
200	43	RCL	
201	01	01	
202	32	X:T	
203	43	RCL	
204	02	02	
205	38	SIN	
206	54	)	
207	54	)	
208	54	)	
209	54	)	
210	22	INV	
211	30	TAN	
212	42	STO	
213	03	03	
214	22	INV	

LOC	CODE	KEY	COMMENTS
215	02	02	
216	38	SIN	
217	54	)	
218	54	)	
219	54	)	
220	54	)	
221	22	INV	
222	30	TAN	
223	42	STO	
224	03	03	
225	22	INV	
226	77	GE	
227	03	03	
228	00	00	
229	43	RCL	
230	03	03	
231	22	INV	
232	88	DMS	
233	91	R/S	
234	99	PRT	
235	00	0	
236	00	0	
237	00	0	
238	76	LBL	North Buoy Station
239	15	E	
240	00	0	
241	32	X:T	Same Layout As South Buoy Station A
242	53	(	
243	53	(	
244	94	+/-	
245	07	7	
246	02	2	
247	00	0	Distance from Station C to Buoy X-Direction
248	85	+	
249	53	(	
250	43	RCL	
251	01	01	
252	65	×	
253	53	(	
254	43	RCL	
255	02	02	
256	39	COS	
257	54	)	
258	54	)	
259	54	)	
260	55	÷	
261	53	(	
262	04	4	
263	05	5	Distance from Station C to Buoy Y-Direction
264	00	0	
265	85	+	
266	53	(	
267	43	RCL	
268	01	01	

LOC	CODE	KEY	COMMENTS
270	53	(	
271	43	RCL	
272	02	02	
273	38	SIN	
274	54	)	
275	54	)	
276	54	)	
277	54	)	
278	22	INV	
279	30	TAN	
280	42	STO	
281	03	03	
282	22	INV	
283	77	GE	
284	03	03	
285	00	00	
286	43	RCL	
287	03	03	
288	22	INV	
289	88	DMS	
290	91	R/S	
291	00	0	
292	00	0	
293	00	0	
294	00	0	
295	00	0	
296	00	0	
297	00	0	
298	00	0	
299	00	0	
300	53	(	Subroutine for Negative Angles
301	43	RCL	
302	03	03	
303	85	+	
304	01	1	
305	08	8	
306	00	0	
307	54	)	
308	22	INV	
309	88	DMS	
310	91	R/S	
311	00	0	

MERGED CODES

62		72		82	
63		73		83	
64		74		92	

8.0 PROPELLENT EMBEDMENT ANCHORS

A single propellent embedment anchor will be installed at each designated marker buoy. A total of ten embedment anchors will be installed.

The assembly, firing and retrieval of the embedment anchors will be directed by CHESDIV and CEL tech reps who will be responsible for the embedment anchor operation.

8.1 MOBILIZATION

One "CHESDIV" (reaction vessel) launch vehicle and one "SUPSAL" (quadropad frame) launch vehicle will be available. The CHESDIV launch vehicle will be retained in the staging area as a spare. The SUPSAL launch vehicle will be loaded on to the construction barge. Major components of the anchor system, including flukes, pistons and wires, will be loaded as space allows.

8.2 INSTALLATION SCENARIO

Installation of the embedment anchors will be accomplished per the following procedure:

1. CHESDIV and CEL tech reps will assemble, with the assistance of the construction barge deck crew, the launch vehicle. This procedure is detailed in the Anchor System Operations Manual.

OPERATIONAL NOTE

The placement of embedment anchors requires the use of explosives and primers. Explosives will be stored in existing on island facilities. Handling and transportation will be coordinated to have only the daily explosives requirement on board the construction barge. The embedment anchor Operations Manual defines precautions required to handle and place explosives.

2. The construction barge crane will be utilized to place the launch vehicle. The barge will be positioned, by a pusher boat, near the marker buoy. The crane will lower the launch vehicle, a final check made of the firing circuit, and the embedment anchor fixed into the bottom. The barge will not be required to anchor during this process.

3. The launch vehicle will be recovered and prepared for the next placement.

4. Each embedment anchor will be tested for holding power. The barge will be moved into position with the beach gear pulling wire over the embedment anchor cable. A diver will be required to connect the pulling wire to the anchor wire.

5. The pulling winch and beach gear will be used to apply a 100K lb. (min.) load to the embedment anchor. The applied load will be indicated on a load cell located near the fixed beach gear block. The applied load will be recorded in the operations log book. The ROICC will be advised of each actual pull test measurement.

6. A diver will be required to disconnect the anchor wire after the pull test.

The installation of each embedment anchor will be accomplished as indicated above.

MOORING MAINTENANCE

Installation of embedment anchors for the mooring maintenance project (Appendix A) will be completed after installation of 100K anchors. The seven 20K embedment anchors will be installed per the 20K Embedment Anchor Installation Manual using the basic scenario as described previously.

9.0 INSTALLATION SCENARIO

The installation scenario can be executed for each mooring site after the following tasks are complete:

1. Pallets offloaded and inspected
2. Complete assembly of pallets with parts not available at CONUS mobilization
3. Crane barge mobilized
4. Survey completed and marker buoys installed.

9.1 The installation is accomplished for each mooring site during the following tasks:

TASK 1 - Place and test 10 embedment anchors. See section 8.0.

TASK 2 - CHAIN LENGTH MEASUREMENTS

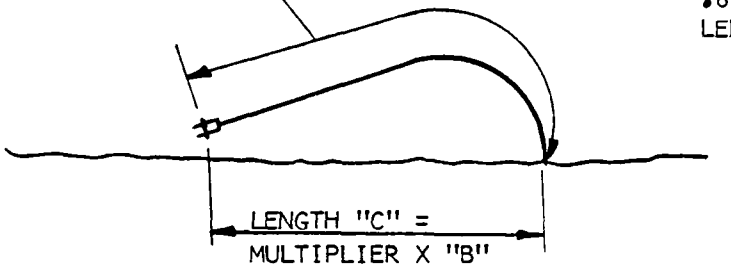
On site measurements are required to cut the 2-1/2" chain between the sinker and the embedment anchor wire. It is anticipated, as determined from previous anchor installations at Diego Garcia, that the anchor will penetrate the bottom 30 to 35 feet thus exposing 15 to 20 feet of 2" diameter anchor wire. The following procedure is required to adjust the length of the 2-1/2" chain in order to maintain a consistent distance between the sinker and the location of impact of the embedment anchor.

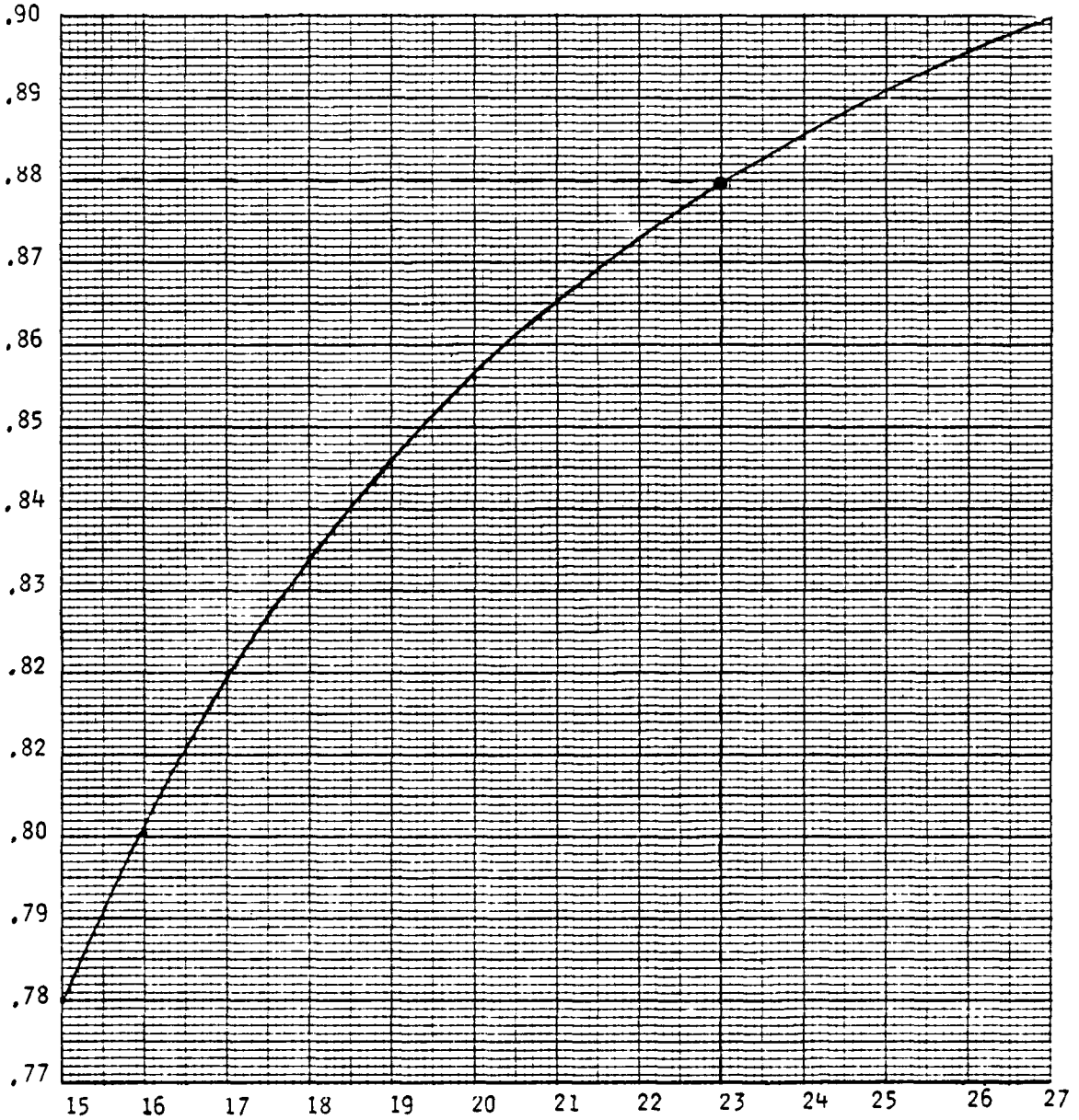
1. Measure the distance from the point of impact of the embedment anchor (where the anchor wire comes out of the bottom) to the center of the sinker float marker weight. This measurement is labeled the "A" dimension.

2. Measure the distance from the bottom to the center of the pin in the open socket at the end of the embedment anchor wire. This measurement is the "B" dimension. Using Figure 16 determine a resultant dimension "C" by multiplying "B" times the factor (multiplier) indicated.

"B" = TOTAL LENGTH OF 2" WIRE FROM BOTTOM TO CENTER OF SOCKET PIN

EXAMPLE BELOW:
B = 23'
MULTIPLIER = 88
.88X23' = 20.24'
LENGTH "C" = 20'-3"





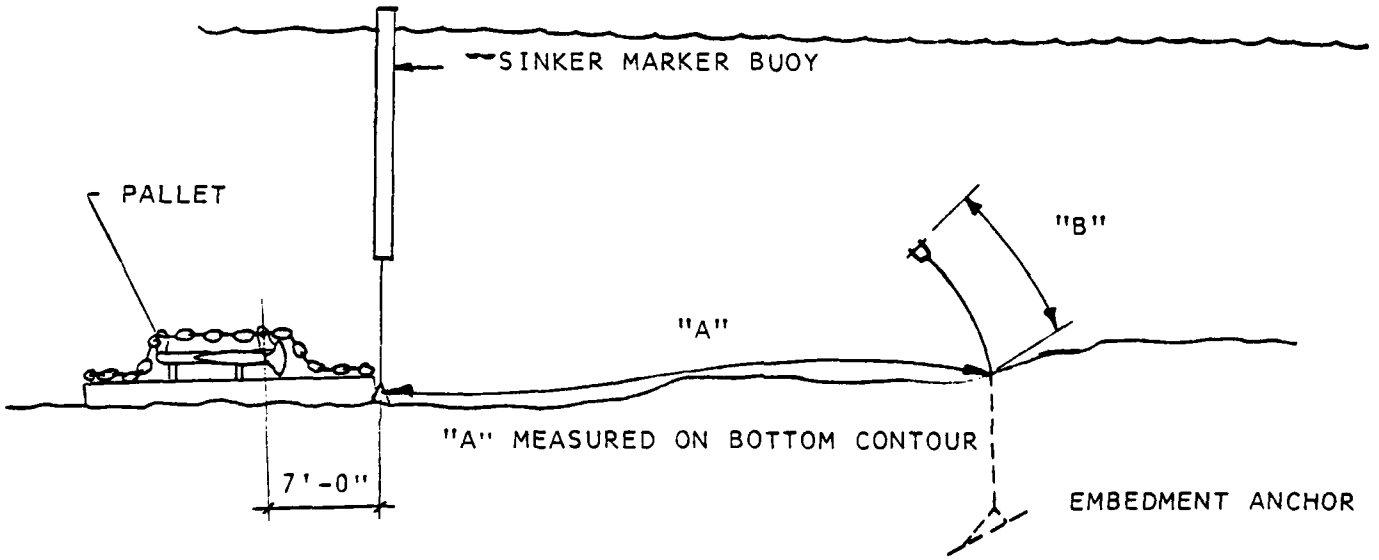
LENGTH IN FEET OF EMBEDMENT ANCHOR WIRE
MEASUREMENT CHART, EMBEDMENT ANCHOR WIRE

FIGURE 16

Example:

Dimension "B" = 23'
Multiplier from figure 16 = .88
.88 x 23' = 20.24'
Length "C" = 20'.3"

3. Establish the dimension to cut the 2-1/2" chain by adding 7'-0" to the "A" dimension and then subtracting the "C" dimension. Reference the figure below.



2 1/2" CHAIN CUT DIMENSION = (A+7'-0") - (B X MULTIPLIER)

- Remove the 2-1/2" chain from the pallet.

- Using the resultant cut dimension, measure from the centerline of the lifting eye near the (flukes) anchor towards the 2-1/2" chain. Cut the chain such that the overall resultant dimension includes all connecting links. Permanently connect the end fitting. Secure the 3/4" diameter galvanized wire for the cathodic protection system to the last 2-1/2" chain link using a special clamp.

- Replace the 2-1/2" chain on the pallet and secure in place.

- Complete Task 2 for each of the mooring legs.

TASK 3 - PALLET MOBILIZATION

Using a crane (30T capacity), lift a pallet onto a flatbed truck. The truck will transit to the outboard south corner of the pier where a crane will offload the pallet and place it on the seafloor. Divers will be required to disconnect the crane hook from the pallet sling. Each of the five pallets for a mooring will be placed on the bottom.

TASK 4 - PALLET INSTALLATION

The 100K sheave on the crane barge will be used to lift the pallets and place them near the embedment anchors. A pusher boat will locate the barge near the pier with the lift wire over the pallet. A diver will secure the lift wire to the pallet. Two tag lines will be connected to the pallet slings near the 2-1/4" chain. Using the deck winch and beach gear lift the pallet near the surface. Secure the tag lines to a deck cleat near the crane end of the barge. The 2-1/4" chain should be facing towards the crane end of the barge. Move the barge toward the proper buoy marker. Directional control of the pallet is maintained using the tag lines. With the barge at dead stop, lower the pallet to the bottom as shown in figure 17. The pallet is disconnected by a diver. Place each anchor pallet as described in task 2, 3, and 4.

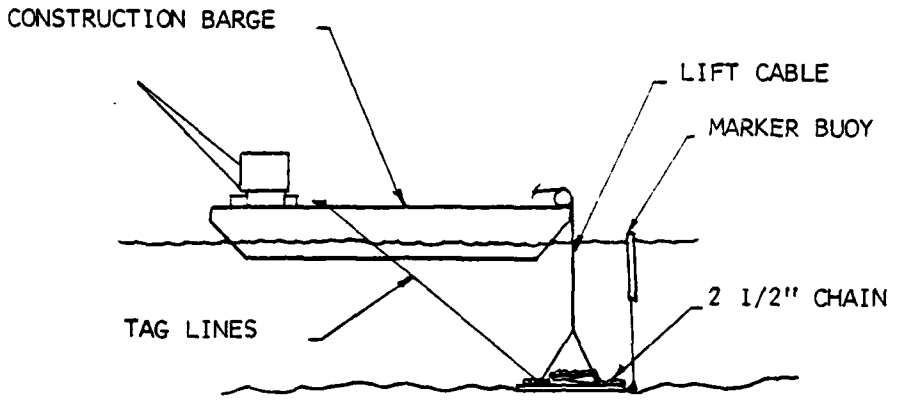


FIGURE 17

PLACEMENT OF PALLET NEAR MARKER BUOY.

TASK 5 - CONSTRUCTION MOORING

Place the barge in a four point mooring utilizing the push boat to move the barge around the established anchor location marker buoys. The barge will be moored with the crane facing the shore. The barge mooring will be effected by wind direction and may be changed on site to allow for conditions.

Mooring near the South end of the pier, the South bollard may be used as a mooring point. A mooring point along the tresele can be established at any expansion joint bent. Using nylon, line pass the line under the pier deck, up and over the pipe line support structures, and returned through the opposite side of the bent.

When mooring near the North end of the pier, an emergency mooring wire will be secured to the embedment anchor wire at N1. This wire will be secured to the barge at a double bitt using wire rope clips.

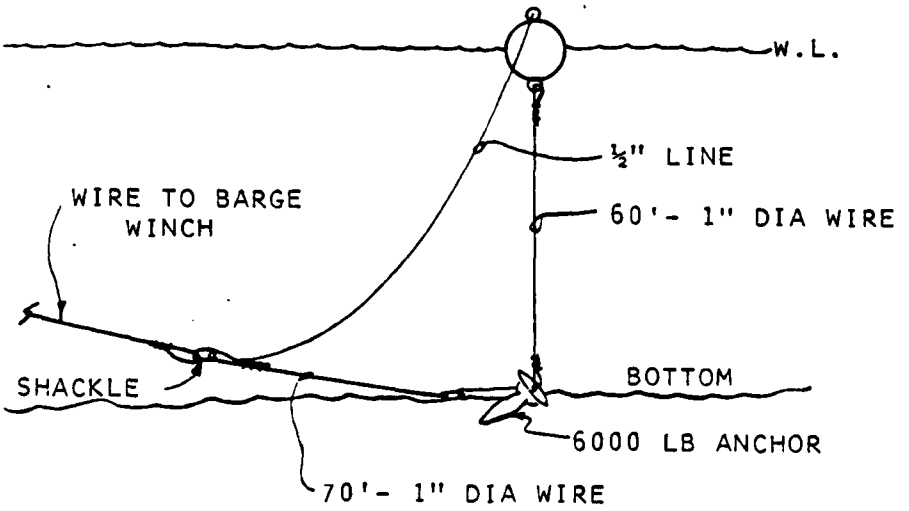
5.1 PLACEMENT OF CONSTRUCTION MOORING ANCHORS

Anchor locations will be marked by buoys during the survey.

The placement of the inboard (towards shore) anchors will be completed using the crane. The crane will lift the anchor from the deck and place it near the marker buoy.

The placement of the two outboard (away from shore) anchors can be accomplished by moving the barge to the anchor buoy marker and then dropping the anchor. The anchor wire is released as the barge moves to the next marker buoy. Outboard anchors will be placed using the stern anchor winches.

With the barge near the center of the mooring, a small boat will be required to attach the anchor wires to the wire pendents attached to the construction anchors. The inboard anchors are rigged as shown below.



INBOARD MOORING ANCHOR BUOY
FOR USE WITH
CONSTRUCTION MOORING

TASK 6 - CHAIN CONNECTION LEG NO. 2

The barge is warped into position over the anchor pallet for leg Number 2. The 2-1/2" chain is secured to the embedment anchor wire using the following procedures:

1. Divers cut the wire bands that hold the 2-1/2" chain.

2. A line is run from a capstan through the clevis on the embedment anchor wire and secured to the third from the end link in the 2-1/2" chain.

3. The line is tensioned, pulling the chain to the anchor wire.

4. A diver disconnects the pulling line and connects the chain and anchor wire. The connection is made by placing the clevis pin on the anchor wire through the 2-1/2" anchor joining link.

5. Secure the cotter pin through the clevis pin.

6. Divers cut the wire bands securing 2-1/4" chain to the pallet.

7. Divers connect the bitter end of the 2-1/4" chain to the crane hook and lift the chain to the deck. Secure the chain to a bow cleat with 6' of chain on deck.

TASK 7 - CHAIN CONNECTION LEG NO. 1 WITH LEG NO. 2

Warp the barge into position over the anchor pallet for leg Number 1. Connect the 2-1/2" chain to the embedment anchor wire as described in task 6. With the 2-1/4" chain from leg No. 1 secured on deck complete the attachment of legs 1 and 2 as follows:

1. Place the 2-1/4" chain through the equalizer. Check the equalizer to ensure that all anodes are securely in place.

2. Connect the 2-1/4" chains from legs 1 and 2.

3. Place a wire strap through the upper section of the equalizer and secure the wire strap to the bow mooring bit with the equalizer at deck level. Do not place the wire strap through the eye on the equalizer.

TASK 8 - CHAIN CONNECTION LEG NUMBER 3

Warp the barge into position over the anchor pallet for leg Number 3. Connect the embedment anchor wire as described in Task 6. Complete the attachment of the anchor leg to the equalizer as follows:

1. Divers place a wire strap through the ground ring and connect the strap to the submerged crane hook.

2. Raise the crane hook to a level where the equalizer shackle (Item 15) can be connected to the equalizer. Warp the barge towards the center of the mooring and near the pallet for leg 2.

CAUTION

Check the relative position of each component and leg, confirming each leg is clear and in proper orientation.

3. Connect the last link of the 3-1/2" chain to a bow bitt. Lower the equalizer into the water and disconnect the crane hook.

4. Secure a marker buoy line to the ground ring.

5. The three primary legs should now be suspended below the bow, with each leg towards its proper anchor pallet.

6. Slack the forward construct mooring lines, and using the stern mooring winches, pull the assembled legs and ground ring towards the center of the mooring. Continue pulling until the ground ring is approximately over the center mooring marker.

7. Take up the slack in the bow mooring lines and slowly ease the stern mooring wires until the 3-1/2" chain is perpendicular to the bottom.

8. Connect the crane hook to the wire strap holding the 3-1/2" chain. Lower the chain and ground ring to the bottom and disconnect the crane hook.

TASK 9 - CHAIN CONNECTION LEG NUMBER

Warp the crane barge into position with the bow over the pallet for leg 5. Connect leg 5 as described in task 6, retaining the end of the 2-1/4" chain at the bow mooring bitt.

TASK 10 - CHAIN CONNECT LEG NUMBER 4

Warp the crane barge into position with the bow over the pallet for leg 4. Connect leg 4 as described in task 6. Complete the assembly of the back stay legs (4 and 5) as described below:

1. Lower the crane hook to the diver and connect a wire through the spider plate eye.

2. Lift the bitter end of leg 4 to the deck

3. Connect the 2-1/4" anchor joining link (item 7) on the spider plate to leg 5.

NOTE

Check the orientation of the plate and each leg and confirm proper direction of each.

4. Lift the spider plate to its max. height with the crane. The crane boom must be centered with the barge and have max. elevation.

5. Slowly stack the sterm mooring wire and tension the forward mooring lines. Warp the barge toward the marker buoy locating the ground ring. As the barge moves forward, slowly lower the crane hook thus allowing the chain to be laid on the bottom towards the ground ring. Lower the spider plate as close to the ground ring as possible.

6. Divers connect the spider plate shackle (Item 11) to the spider plate. Final movement of the ground ring to the spider plate may require the use of a com-a-long or top side assistance.

CAUTION

The ground ring/spider plate connection must be made in the proper orientation. Connect a line to the bitter end of the 3-1/2" chain and lift (using the deck capstan) until the ground ring is approximately 5' off the bottom. Inspect the ground ring connection and confirm the mooring legs are properly connected.

TASK 11 - INSTALLATION OF THE MODIFIED PEG TOP BUOY

Prior to installing the buoy the following items are to be checked:

1. Buoyancy control piping is secured in place and all valves are closed. Reference Figure 21.

2. Check exterior surfaces for paint damage. Repair damaged areas by sanding and repainting using 3 coats of paint provided.

3. Check that anodes are secured in place.

4. Check all buoy openings and manholes. Confirm that each is secured.

The mooring buoy is installed using the following procedures:

1. Transit the buoy from the storage area to the outboard end of the pier. Using a four part sling connected to the side lifting eyes, lift the buoy into the water. Secure the buoy to a pusher boat and transit to the bow of the crane barge.

CAUTION

The mooring buoy is not stable while floating. Maintain control of the buoy (using tag lines) during transit and handling. Do not attempt to stand on the deck of the buoy while it is floating free.

2. Secure the four part sling to the main crane hook.

3. With the buoy secured to the bow of the barge, pass the auxiliary crane lifting wire through the center pipe of the buoy. Divers connect the wire to the last link of the 3-1/2" chain.

4. Remove the 2" plugs from the four stand pipes on the buoy manhole covers. Attach the buoyancy control hose to the piping on the buoy. Open all vent valves. Reference Figure 18.

5. Pump water into the buoy using each stand pipe equally. Slowly submerge the buoy. As the buoy goes below the water line maintain depth control using the crane. When the buoy is below the bottom of the barge, tension the auxiliary crane lifting wire until the ground ring is just off the bottom.

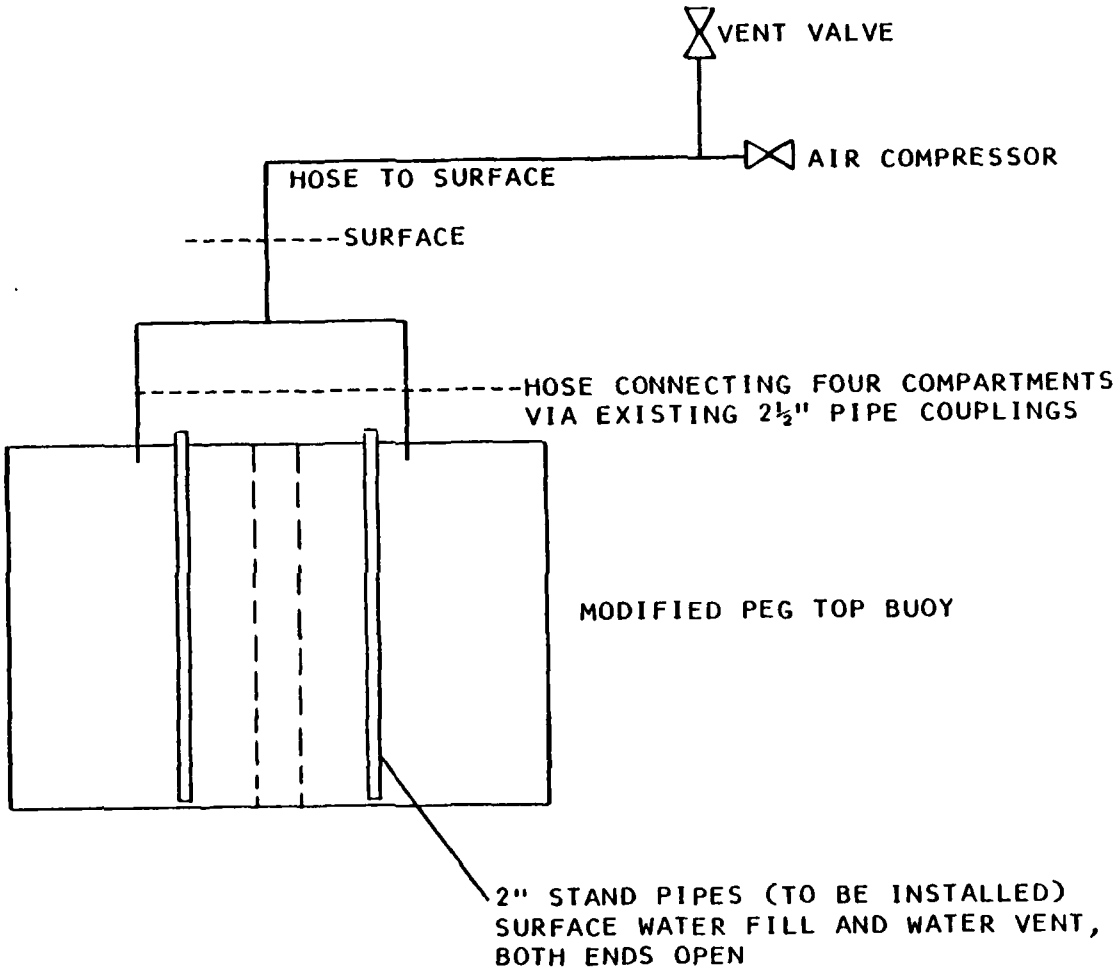


FIGURE 18
BUOY WATER FILL AND VENTING SYSTEM

6. Lower the buoy using the auxiliary lift wire as a guide wire. With the buoy on the bottom divers confirm that rubbing casting (item 6) is inside of the center pipe of the buoy.

7. Divers place a keeper bar through the top of the second 3-1/2" link. Lower the auxiliary lift wire and disconnect. The 3-1/2" chain is now secured by the keeper bar.

8. Place the buoy center pipe cover place (3017728 - item 2) over the upper link of the 3-1/2" chain. The 2" x 2" reinforcing plates on the cover plate must be down and facing the deck of the buoy.

9. Install a 3-1/2" anchor joining link (item 4) into the upper link of the 3-1/2" chain. The final assembly of the link can be completed on the surface. Reconnect the auxiliary lifting wire and tension the wire until the keeper bar can be removed.

10. Slowly slack the lift wire and lower the cover plate to the buoy surface. Disconnect the auxiliary lift wire. Align the cover plate bolt holes with the threaded holes in the buoy by using a pry bar to turn the chain. Do not use the threaded holes to pry against. Secure the cover plate with a minimum of six bolts.

11. Tension the main lift wire until the buoy is upright and slowly blow air into the buoy. Continue to blow air into the buoy until the buoy is afloat and all water is removed from the interior of the buoy.

12. Disconnect the lift wire and complete assembly of items 2, 3, and 4.

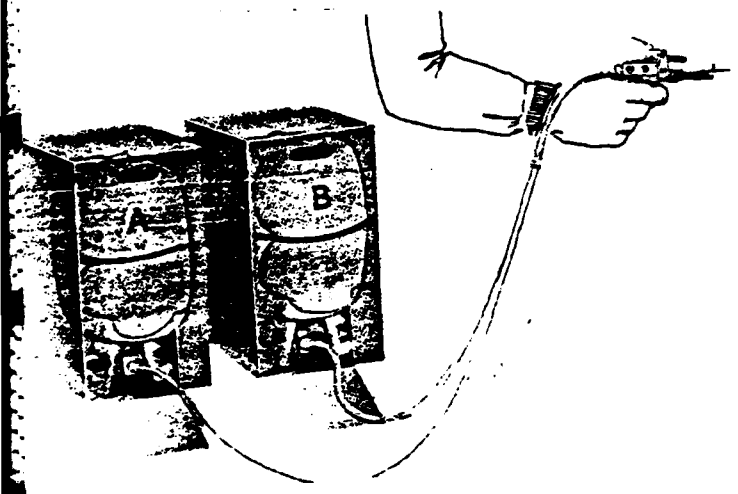
13. Remove all buoyancy control piping and secure plugs.

14. Remove the manhole inspection plates and stand pipes. Remove any residual water and dry the interior of the buoy.

10.0 INSTALLATION OF FOAM BUOYANCY MATERIAL

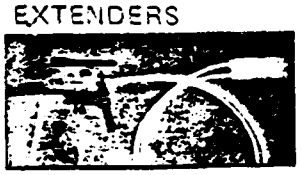
Urethane foam to be installed in the buoy will be shipped in kit form. The foam is a commercial product known as "Insta-Foam, Froth-Pak" kits. (A registered trademark of Insta-Foam Products, Inc., Joliet, Illinois 60435).

Each kit consists of a part A and part B chemical in a pressurized container. The two containers are attached to hoses which terminate at a controllable mixing "gun." Each foam kit will be installed per the manufacturers instructions, while observing all warnings and precautions as noted on manufacturers instructions.



BASIC FOAM KIT

EXTENDERS



Gun Nozzle Extender Kit— The basic kit includes the necessary connectors for the gun body and the nozzle (to permit use of extending plastic tubing).

PHYSICAL PROPERTIES

	1¾-POUND DENSITY
	The 1.75 lbs/cu.ft. rigid foam is available at two levels of reactivity – standard and slow-rise, for larger "froth-in-place" applications with less hazard of splitting and scorching due to exotherm. High strength-to-density ratios and low K-factor (insulation value) are key properties which make this product the most consistent, most versatile "problem solver" in the INSTA-FOAM® product line.
DENSITY, pcf	1.75
Compressive Strength, psi @ yield point % parallel to rise	16 @ 10
Perpendicular to rise	15 @ 10
Tensile Strength, psi @ yield point, % parallel to rise	20 @ 2
Perpendicular to rise	24 @ 2
Flexural Strength, psi Parallel to rise	40
K-Factor, BTU/hr/°F/ft.²/in Aged 140°F, 6 months	.16
Water Vapor Transmission Perm/inches	2.0
Closed Cell Content, %	90+
Dimensional Stability % vol. change 7 days, 158°F, 100% r.h.	+18
2 Days, −16°F	−2.0
ASTM E-84 Flame Spread*	60
Smoke Density*	400

11.0 CATHODIC PROTECTION SYSTEM

The final assembly of the cathodic protection system is detailed per Figure 18 and includes the following items:

1. With the mooring in the static (no load) position, measure down from each side of the equalizer 15' and cut the 3/4" galvanized wire. Secure the end of the cable to the 2-1/4" chain using a special clamp. Repeat the process for the opposite equalizer leg.

2. Check each clamp connection and confirm the clamp is secure.

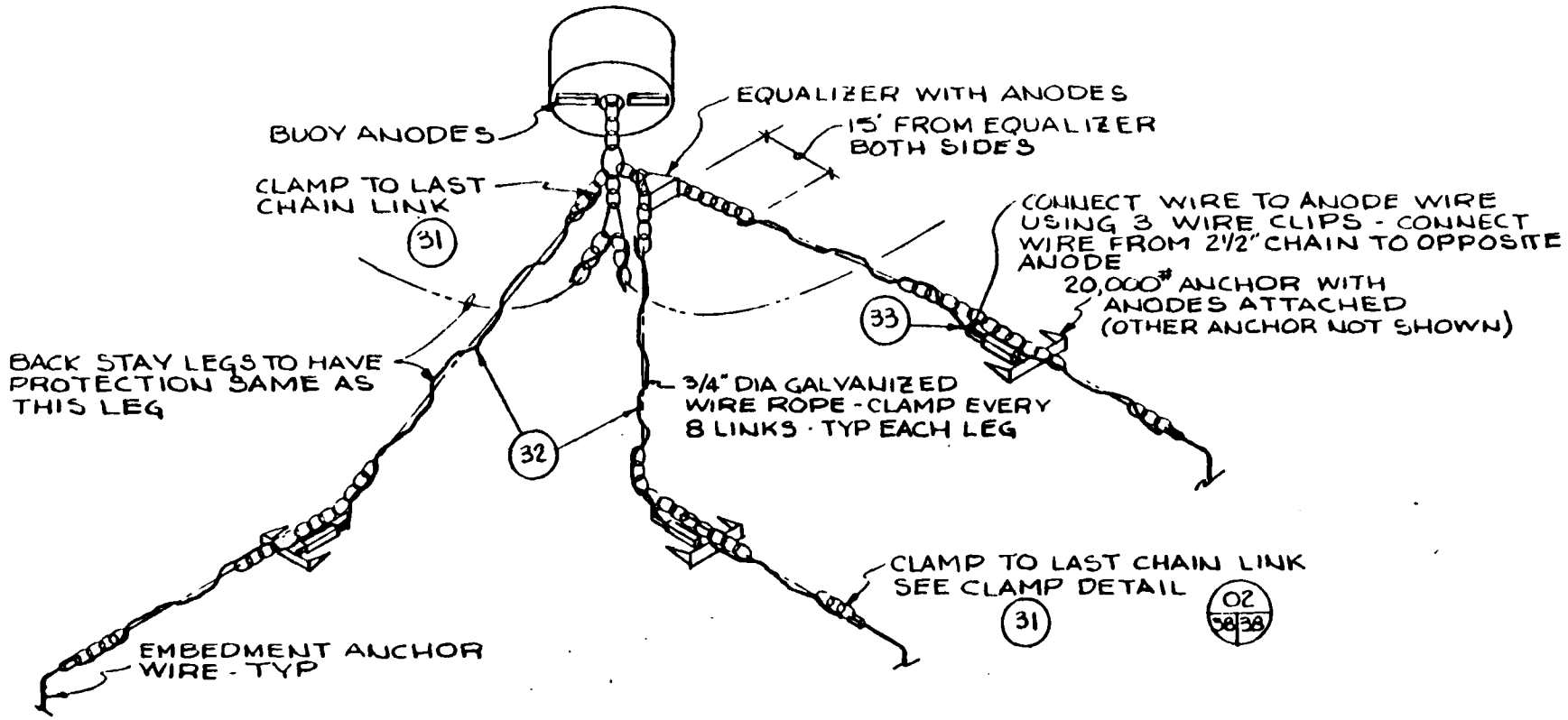


FIGURE 19

CATHODIC PROTECTION SYSTEM DIAGRAM

REFERENCE NAVFAC 3017738

12.0 MOORING INSPECTION

The mooring inspection will document the final placement and as-built construction of the mooring. The inspection will be conducted using manual measurements, still photographs and the UDAT (TV) system. The inspection will include the following:

1. Survey final location of each buoy
2. Electric potential readings of cathodic protection system
3. Still photographs of each major mooring component
4. Through visual inspection, i.e., cotter pins, hardware pins.

An inspection report will be generated by CHESNAVFAC Tech Rep on site and will be distributed to the ROICC, and will be used as the basis for "as-built" documentation.

PROJECT EXECUTION PLAN

FLEET MOORING MAINTENANCE
DIEGO GARCIA B.I.O.T.

By
K. COOPER

Approved by: John O. Ess 1-15-80
JOHN ESS, Manager
Engineering and Design
Branch

Approved by: _____
C.E. BODEY, Director
Engineering and Design
Division

OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON NAVY YARD
WASHINGTON, DC 20374

APPENDIX A

TABLE OF CONTENTS

PROJECT DESCRIPTION

Fleet mooring maintenance required at Diego Garcia, B.I.O.T. is identified as the result of an underwater inspection conducted by UCT-2. The inspection report (Appendix 1) describes the present condition of the moorings. CEL letter (Appendix 2) outlines required maintenance. It is important that Appendix 1 and Appendix 2 be read in conjunction with the body of this installation plan.

The general layout of a propellant anchor mooring legs were incorporated into mooring designs, and construction drawings were prepared for the temporary and permanent sites by PACDIV.

The single two-anchor hookup shown in Figure 1 was used at the temporary site. At the permanent site, a short length of chain was added between the buoy and the load equalizer to place the equalizer below the draft depth of ships using the facility. Also, two 750-pound (3.3 kN) LWT anchor backlegs were added to retain the buoys in their desired position when not in use, and a slack backup leg consisting of two 6,000-pound (27 kN) STATO anchors and three shots of chain was added to provide emergency protection in the event of failure of one or both propellant anchors; this configuration is shown in Figure 2. On the turning point leg at the permanent site, four propellant anchors were used, with the outer two connected through an equalizer; the LWT and STATO legs were omitted.

Maintenance to be accomplished includes the following items:

1. Temporary mooring (Reference Figure 1)

   a. North buoy - install embedment anchor, replace zincs, install wire clips around kinks in wire

   b. South buoy - install embedment anchor, replace zincs, install wire clips around kink in wire

   c. North East - install embedment anchor, replace zincs

   d. North West - install embedment anchor, replace zincs, shorten leg L2 and install wire clips

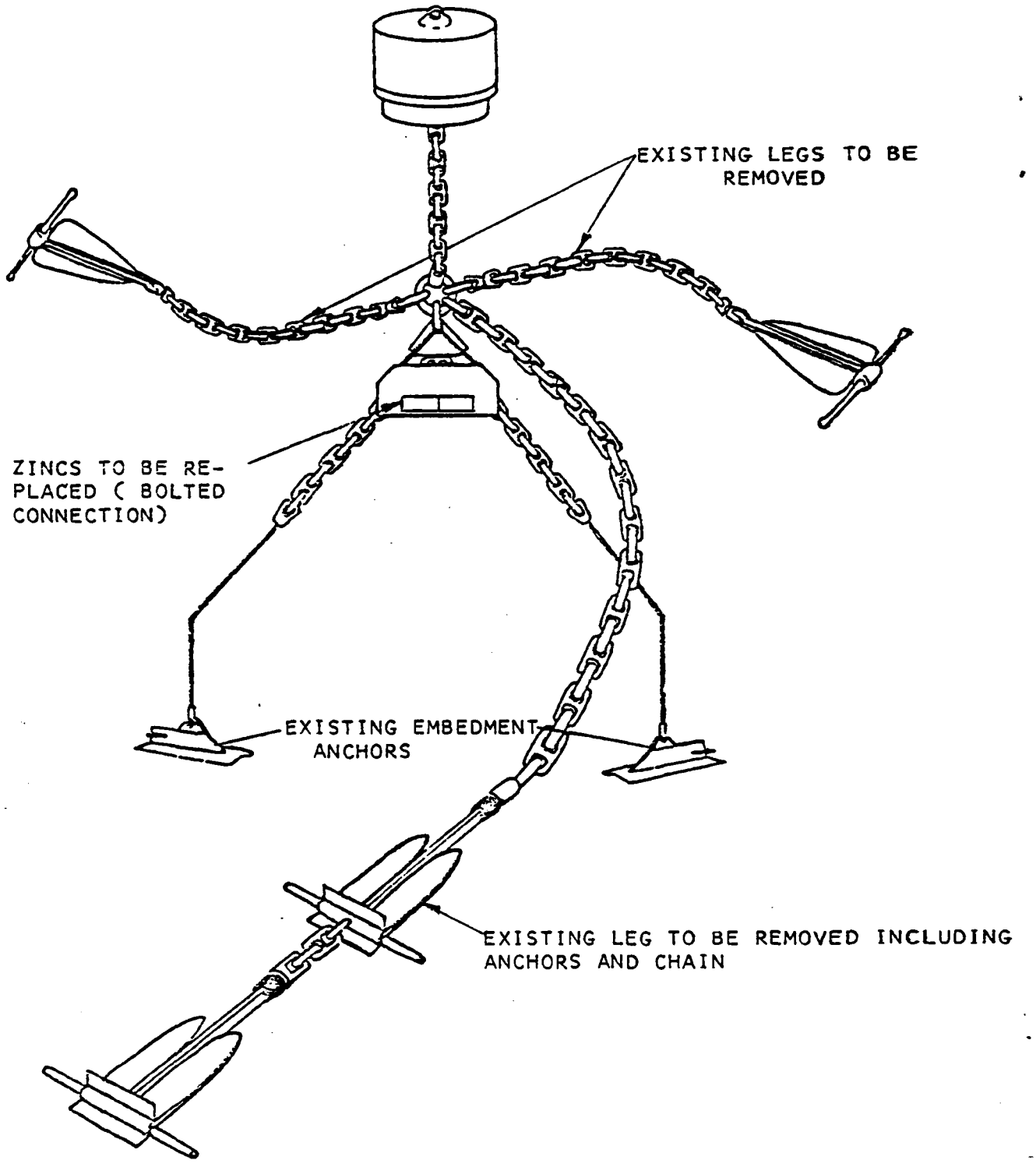
2. Permanent mooring (Reference Figure 2)

   a. North buoy - install embedment anchor, replace zincs, untangle chain and remove backstay legs

   b. South buoy - install embedment anchor, replace zincs, remove backstay legs

   c. East buoy - replace zincs

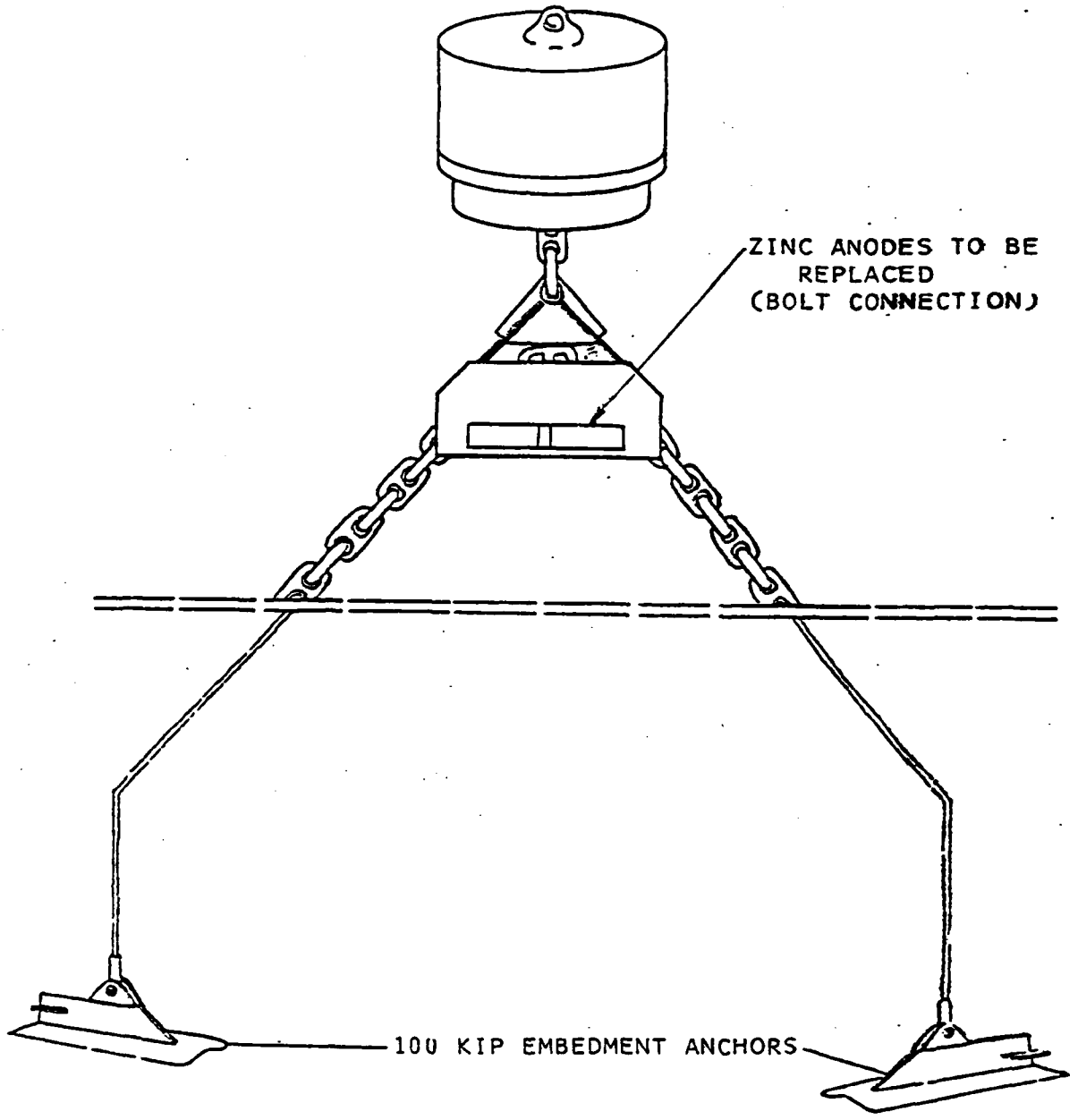
   d. West buoy - install embedment anchors, replace zincs, remove backstay legs



MOORING LEG CONFIGURATION

PERMANENT SITE

FIGURE 2



MOORING LEG CONFIGURATION
TEMPORARY SITE
FIGURE 1

ORGANIZATIONAL RESPONSIBILITIES

CHESNAVFAC (FPO-1) - Project coordination and scheduling. Installation of embedment anchors on site.

CIV ENG LAB - Provide all project materials including embedment anchors and support items. Installation of embedment anchors on site.

NSF DIEGO GARCIA - Provide diving support to hook up embedment anchor wires, replace zincs and cut or disconnect chain for anchor backstay leg removal. Provide barge with A-frame.

30th NCR - Provide deck crew, and equipment operators.

UCT-2 - Provide technical assistance.

OPERATIONS PLAN

Mobilization - All materials and equipment will be transported by ship to Diego Garcia.

Embedment Anchor Installation - Embedment anchors will be installed in conjunction with anchor installation of the Pier Buoy Mooring Project. The crane barge will be positioned with the bow moored to the buoy. The embedment anchors will be prepared for placement by the CHESNAVFAC and CEL tech. reps. with assistance from the deck crew. The crane barge will then be moved into position by the push boat and the crane will lower the anchor. Upon bottom contact, the anchor will fire and impact the bottom. The anchor wire will be secured to a marker buoy for later recovery.

Mooring Maintenance - It is presently proposed that NSF will provide a diving team. The tasks to be accomplished after anchor placement may be completed on a diver availability basis. The following scenario gives priority for the accomplishment of the major tasks requiring several divers and lift capability.

OPERATIONAL NOTE

It is feasible that some of the mooring maintenance can be accomplished above water. In this case, the A-Frame hook would be attached to the ground ring and the ground ring lifted to the deck area. The barge would be secured to the anchor chains at a point below the equalizer. This plan is suggested as an optional method pending field evaluation.

Permanent North Buoy - The barge will be moored to the buoy and may be released by the push boat.

Removal of the three backstay anchor legs, as shown in Figure 2, will require removal of the links joining the chain to the ground ring. Underwater burning may be the most expeditious method of removal, however, the A-Frame may be able to lift the ground ring to the surface.

A wire choker will be placed through the chain and attached to the hook. The A-Frame will lift the chain and anchors on deck, for later use as surplus material on island. The removal of backstay legs (3 chains each) will be repeated on three of the permanent mooring buoys.

Each 20K embedment anchor is placed with an anchor wire connected to it. The anchor wire will be attached to the hardware under the buoy and will be utilized as a backstay leg.

Each backstay anchor wire at the permanent mooring site will be connected to the ground ring. Each backstay anchor wire at the temporary mooring will be connected to the equalizer shackle. In each case, the anchor wire will be connected by a diver with rigging assistance from the surface craft to lift the anchor wire to the proper connection point.

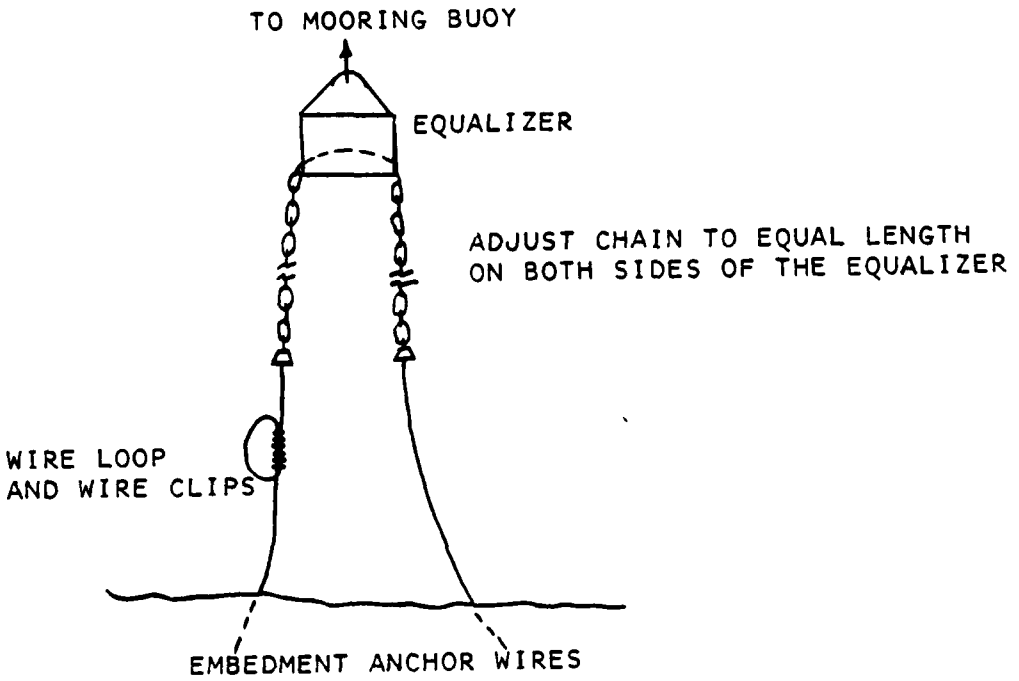
The zinc anode cathodic protection attached to the side of each equalizer will be replaced. In the majority of cases, the cathodic protection is missing or severely deteriorated. The zinc anode is removed by removing the attachment nut and bolt hardware. The hardware is recessed into the anode material. Removal will be by the use of a rachet and socket. If possible, zincs will be brought to the surface for examination and measurement for use in corrosion resistance evaluation. The contact area of the replacement zinc must be cleaned using a wire brush prior to attachment of the replacement anode. This operation will be repeated on each mooring equalizer.

Permanent South and West Buoy - Operations will proceed in the same manner as for the permanent North buoy.

Temporary Northwest buoy - Attach the embedment anchor wire to the ground ring and install zincs as previously described.

Temporary Northwest buoy - Attach the embedment anchor wire to the ground ring and install zincs as previously described.

Leg L2 of the embedment anchor wire must be shortened. A wire com-a-long will be attached to the anchor wire near the bottom. The opposite end of the com-a-long will be made fast to the eye connecting the wire to the chain. The diver will operate the com-a-long thus pulling the chain through the equalizer until an equal length of chain is on each side of the equalizer. The anchor wire will be shortened by forming a loop in the wire and placing wire clips on the overlaping wires. (Remove the wire com-a-long.)



Temporary North - Conduct maintenance the same as for Temporary Northeast buoy. Inspection report (page D-19) indicates 3 kinks in the anchor wire.

Temporary Northeast and Permanent East - Attach the embedment anchor wire to the ground ring and install zincs as previously required.

Temporary South buoy - Attach the embedment anchor wire to the ground ring and install zincs as previously described.

The kink in the embedment anchor wire will be repaired by folding the wire back on itself and installing wire clips on each wire. The kink in the wire will be located in the loop formed in the wire. Wire clips will be tightened using a hydraulic impact wrench provided by the project.

OVERALL PROJECT SCHEDULE

Proposed as of November, 1979

January 1980 - Complete mobilization of anchor equipment at Port Hueneme for surface shipment to Diego Garcia

April - June 1980 - Install 20K embedment anchors using crane barge mobilized for Buoy Mooring Project

- NSF divers use A-Frame barge to complete project assisted by UCT-2 and CHESNAVFAC Tech. Reps.

EQUIPMENT/MATERIALS REQUIREMENTS

( ) indicates provision responsibility

QTY		
7 sets	20 kip embedment anchors with wire anchor pendent	(CEL)
1 ea	20 kip embedment anchor gun	(CEL)
1 ea	20 kip embedment anchor support items and spares	(CEL)
1 Lot	anchor wire attachment hardware	(CEL)
32 ea	zincs and hardware	(CEL)
1 Lot	wire rope clips	(CEL)
1 ea	hydraulic impact wrench with sockets of proper size to secure wire clips	(CEL)
1 ea	hydraulic power supply with connecting hoses	(UCT-2)
1 Lot	diving equipment	(NSF)
1 Lot	rigging gear - wire "com-a-long" or similar device	(NSF)
1 Lot	cutting equipment for removing existing back leg hardware	(NSF)
1 ea	barge with A-Frame - wire must have sufficient wire to reach bottom at (-) 75	(NSF)
1 ea	push boat - sized suitable to move crane - barge	(NSF)

CIVIL ENGINEERING LABORATORY
NAVAL CONSTRUCTION BATTALION CENTER
PORT HUENEME, CA 93043

LEC 16 Jan 79
LRC

IN REPLY REFER TO

L42/RAB/pm

SERIAL 28

JAN 15 79

From: Officer in Charge
To: Commander, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, HI 96860

Subj: Tanker Moorings at Diego Garcia; maintenance of

Ref: (a) Fonecon btwn M. Nagachi (PACNAVFACENGCOM) and D. True (CIVENGRLAB) of 8 Dec 1978
(b) UCT-Two Rept, "Mooring Inspection Diego Garcia," undated (forwarded Feb 1978)
(c) CIVENGRLAB Drawing 74-37-2F of 19 Nov 1974
(d) PACNAVFACENGCOM Drawing 7,900,609 of 25 Mar 1975

Encl: (1) Excerpts of reference (c) showing equalizer

1. By reference (a), maintenance needs identified in reference (b) were discussed and CIVENGRLAB recommendations were requested.

2. In the "temporary" mooring, needs are (a) replacement of zinc anodes on the equalizers for all buoys for cathodic protection, (b) attachment by divers of a safety section of wire with clips, over a kinked point on one of the anchor cables on the "south" buoy, and (c) adjustment of the chain in the equalizer and possible shortening of cable L2 on the "northwest" buoy by divers making and securing a loop with clips.

3. In the "permanent" mooring, needs are (a) replacement of zinc anodes on the equalizers for all buoys for cathodic protection, (b) untangling and simplifying the mooring configurations by removing the LWT backlegs, tandem STATO backup legs, and riser chains. The backup legs are not needed, as the capacity and durability of the anchors and wire cables have been proven. The 6000 lb STATO anchors thus salvaged may be put to good use elsewhere, as discussed in reference (a). The 750 lb LWT backlegs should be eliminated as they do not hold in coral and thus are not performing their function of maintaining the buoy's positions when the mooring is unoccupied or when the buoys are used individually to moor small vessels.

4. For all buoys (permanent and temporary) except the "turning" buoy (east "permanent" buoy), it is recommended that small (20K lb nominal working load) propellant embedment anchors and one-inch diameter wire rope cables be installed, one per buoy, as backlegs, as they would function properly in coral and provide sufficient capacity for swing-mooring small vessels. As discussed in reference (a), this installation could be coordinated with a planned use of the propellant anchor hardware for construction moorings for a pier installation involving CHESNAVFACENGCOM

L42/DNT/pm

Subj: Tanker Moorings at Diego Garcia; maintenance of

in the summer of 1979, thereby permitting the sharing of mobilization costs. (The east permanent buoy was installed with two extra large (100 K lb nominal working load) propellant anchors serving to secure the buoy against loading from any direction; hence, it would not need additional backley support. This point should be verified, however, as Figure 3-12 of reference (b) does not show whether or not the two extra propellant anchors are still connected properly.)

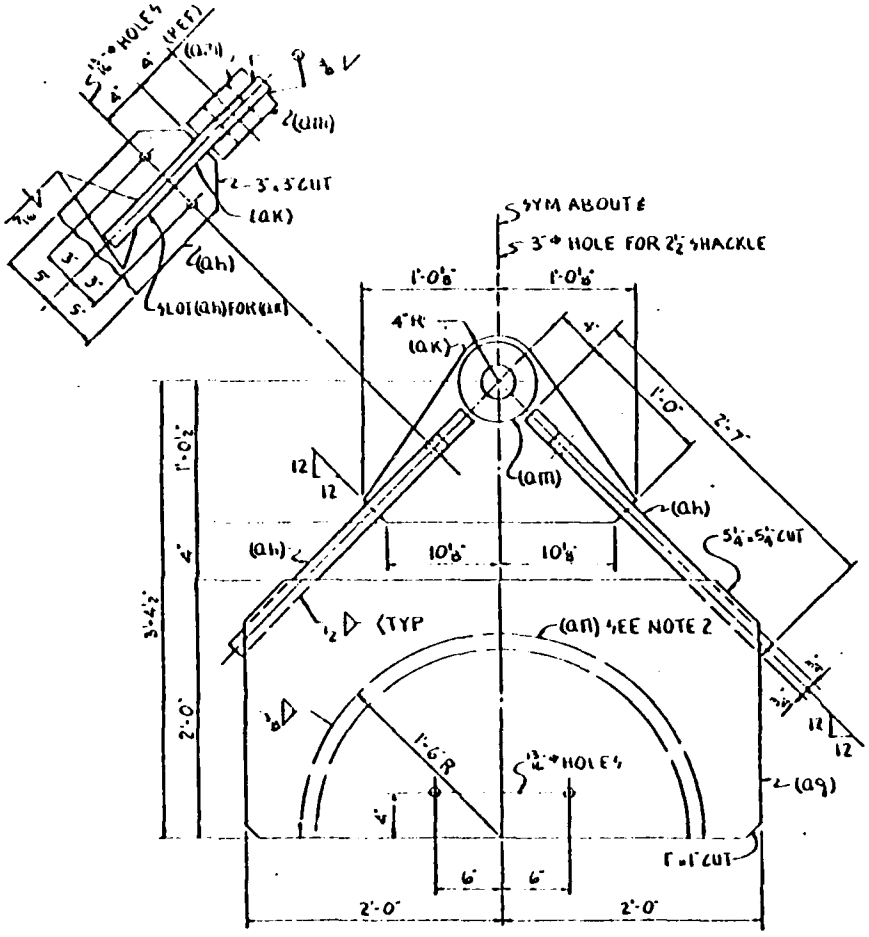
5. Details of the equalizer, needed for anode replacement, are given in references (c) and (d); a reduced copy of the parts of reference (c) pertaining to the equalizer is forwarded as enclosure (1) for handy reference.

6. Anode specifications/procurement information, and further details regarding maintenance and adjustment measures are available from CIVENGRLAB. Details regarding 20 K anchor installation are available from CHESNAVFACENGCOM. Contacts are:

CHESNAVFACENGCOM: K. Cooper, A/V 288-3881
CIVENGRLAB: D. True, A/V 360-4650

H. L. Gill
By Direction

Copy to:
NAVFACENGCOM (Code 03)
NAVFACENGCOM, PW-2
CHESNAVFACENGCOM (Code FPO-1)
CHESNAVFACENGCOM (Code FPO-1 RDC)
OCI-140
NAVSUPPAC, Diego Garcia
All w/encl



ONE-EQUALIZER-2E1
(FLAME CUTTING PERMITTED)

NOTES

2. LENGTH OF ℄ (QN) GIVEN IN BILL OF MATERIAL IS EXACT. ANY EXCESS REQUIRED FOR BENDING SHALL BE DETERMINED BY THE FABRICATOR.
3 WELDING RODS USED SHALL BE AWS A5.5 E10 XX FOR ALL ASA MATERIAL, E70XX FOR ALL ASTM MATERIAL AND TUASIA, EXCEPT FOR 2P3 SEE NOTE 5

1"-thick A514 (USS T1) used in lieu of 1½"-thick A36

QN	ONE	R 1⅛ = 10	4	6 1/16	ASTM A514, SEE NOTE 2
QM	2	BAR 7 ϕ	0	1	- - -
QK	ONE	R 1⅛ = 10½	2	0¾	- - -
QH	2	R ⅞ = 10	2	7	- - -
QQ	2	R ⅞ = 24	4	0	ASTM A514

ONE-EQUALIZER-2E1

MARK	NO. REQ'D	SIZE	FT	IN LENGTH	REMARKS

BILL OF MATERIAL

PROJ NO 42-030
CEL DWG NO 74-37-2F

DEPARTMENT OF THE NAVY
CIVIL ENGINEERING LABORATORY
PORT HUENEME, CALIFORNIA

PROPELLANT HANDLING
SALVAGE ANCHOR SYSTEM
EXCERPTS SHOWING EQUALIZER
MISCELLANEOUS HARDWARE

F 80091

Encl (1)

MOORING INSPECTION DIEGO GARCIA

PREPARED BY:

UNDERWATER CONSTRUCTION TEAM TWO, PORT HUENEME, CA 93043

DIEGO GARCIA BUOY SYSTEMS

BACKGROUND

The Buoy Systems at Diego Garcia (BIOT) British Indian Ocean Territory are of two (2) general types: One being Mooring Buoys and the other Marker Buoys.

The Mooring Systems were installed by UCT ONE and the Civil Engineering Labortory in 1975. The moorings have had only spot visual inspections since then. The Commander, Pacific Division, Naval Facilities Engineering Command requested UCT TWO while on island to do an indepth inspection of the moorings which are propellant embedment anchor type.

The other buoys; Channel, Anchor Basin, and Cement Ship Mooring Buoys were inspected at the same time at the request of the 30TH Naval Construction Regiment. These Buoys were installed prior to the mooring buoys by the Coast Guard.

APPROACH AND SCOPE

The mooring hardware inspection was performed by Underwater Construction Team TWO. A detailed underwater mooring inspection had never been performed previously; thus, procedures and the required documentation forms were devised and various pieces of equipment to support the task were gathered or made.

This report described the inspection,equipment and procedures utilized, summarizes the inspection data, and describes corrective action for the Diego Garcia Harbor Buoy Systems.

GENERAL

The following will summarize the procedures and describe the equipment used during the inspection.

A hardware inspection, performed underwater, was considered to be the quickest and most economical means of establishing the general condition of the buoy systems in the Diego Garcia harbor. This type of inspection cannot replace a detailed inspection performed after buoy retrieval, but it can suggest the deferral or expedition of a major overhaul. Also, by concentrating on areas of the mooring where the probability of significant corrosion and/or abrasion are likely, degradation merely requiring that the mooring be downgraded in class might be discovered. Diver bottom time was the most critical parameter controlling the inspection; thus the "sampling" approach was devised as a necessary approach due to the depths and limited manpower.

EQUIPMENT

The basic equipment required for the underwater inspection were calipers, chipping hammers and scrapers, a plexiglass slate, a one foot rule, grease pencils and a wire brush. The calipers were made from 1 foot wing dividers with the first 1/4" of the tips bent at a 90 degree angle towards the other leg of the wing dividers (Figure 1a). The 1 foot steel rule was mounted to the 15"x18" plexiglass slate 1/3 of the way across. (Figure 1b).

PROCEDURES.

The divers were briefed on what was supposed to be there when prints were available. When not available, a pre-inspection dive and drawings were made. On the actual inspection dive, as the divers descended, a drawing of what was actually in place was made on the first third of the slate. The measurements

were taken on the assent portion of the dive, The major points of measurement were at the Anchorage (AJL)(Anchor Joining Link); at the point where the chain rubbed bottom due to the tide and wave action (AWP)(at ware point) the ground ring, a circular link used to attach more than one leg of anchor chain; at a point one half of the water depth, and where the chain attaches to the buoy. All other points of interest were noted and/or measured as the divers traveled between measuring points, The measurements were taken after chipping rust, animal and plant life away (Figure 2). At all measurement points 6 measurements were taken, 3 double link (Figures 3 and 4), and three single link (Figure 5) using separate links for each measurement. General guidelines for the measurements were taken from the Navy mooring Maintenance Manual. This manual recommends single link measurements to determine whether the chain is suitable for its present classification. Chain wire diameter greater than 90 percent of original chain size is considered adequate. Chain wire diameter between 80 percent and 90 percent of original size should be reduced in classification. Chain wire diameter less than 80 percent of the original size indicates it should be excessed. These suggested measurements were used on all single link measurements. Double link measurements were included to indicate link to link wear as well as corrosion (Figure 6). Basically, the same criteria sizes were twice those for single link.

Approximately 70 percent of the divers time was spent chipping. A mechanical device would have greatly speeded up operations, therefore making diver bottom time not so critical.

All chains or cable were followed to the end or until the divers could no longer follow it because of burying itself in bottom sediment.

Other figures of interest are Figure 7 showing typical growth on the chain, Figures 8 and 9 showing the divers transferring measurements from

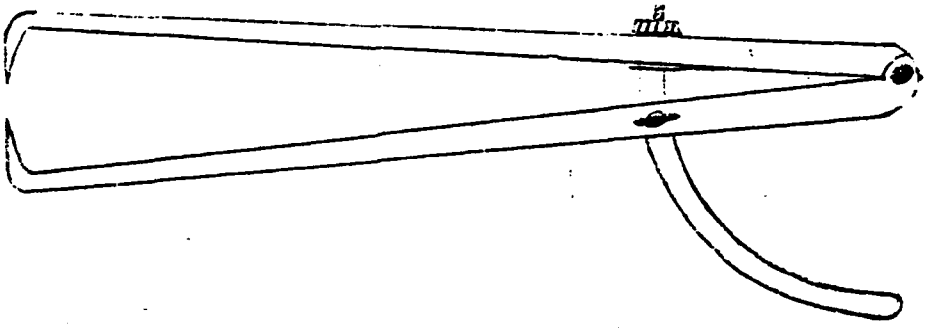
calipers to rule and to slate. Figure 10 showing buoy counter-weight wear points.

Appendix A shows the location of the buoys.

(1) The chart of DIego Garcia, Chart #61611. All buoys are marked and charted as on the harbor masters chart for said island.

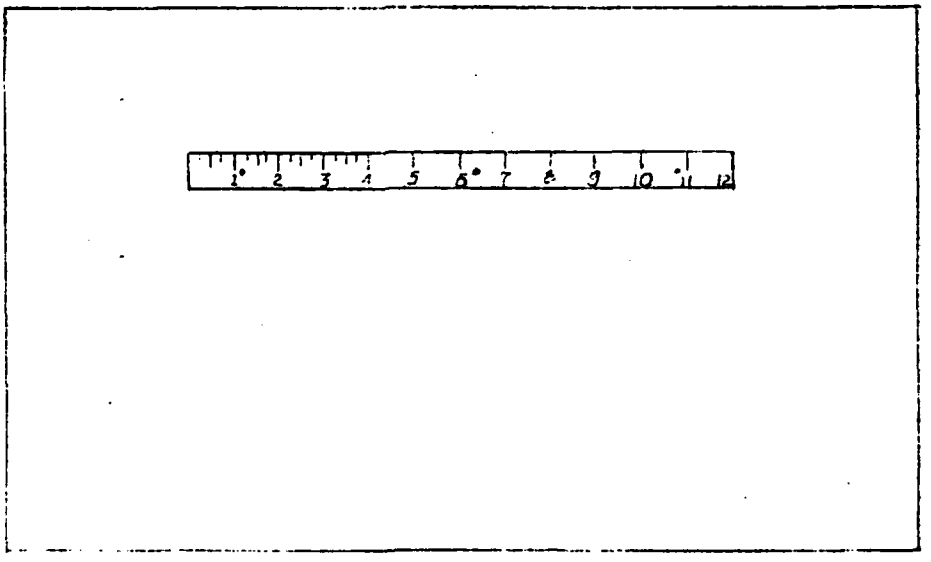
(2) Drawing # DG77-CA-160-1D Public Works Department, Diego Garcia shows locations of buoys noted on the above chart.

Drawings as made by the divers are found in Appendix "B". The report by CEL on the Tanker Moorings as installed is included as Appendix "C". The results of the inspection are forwarded as Appendix "D".



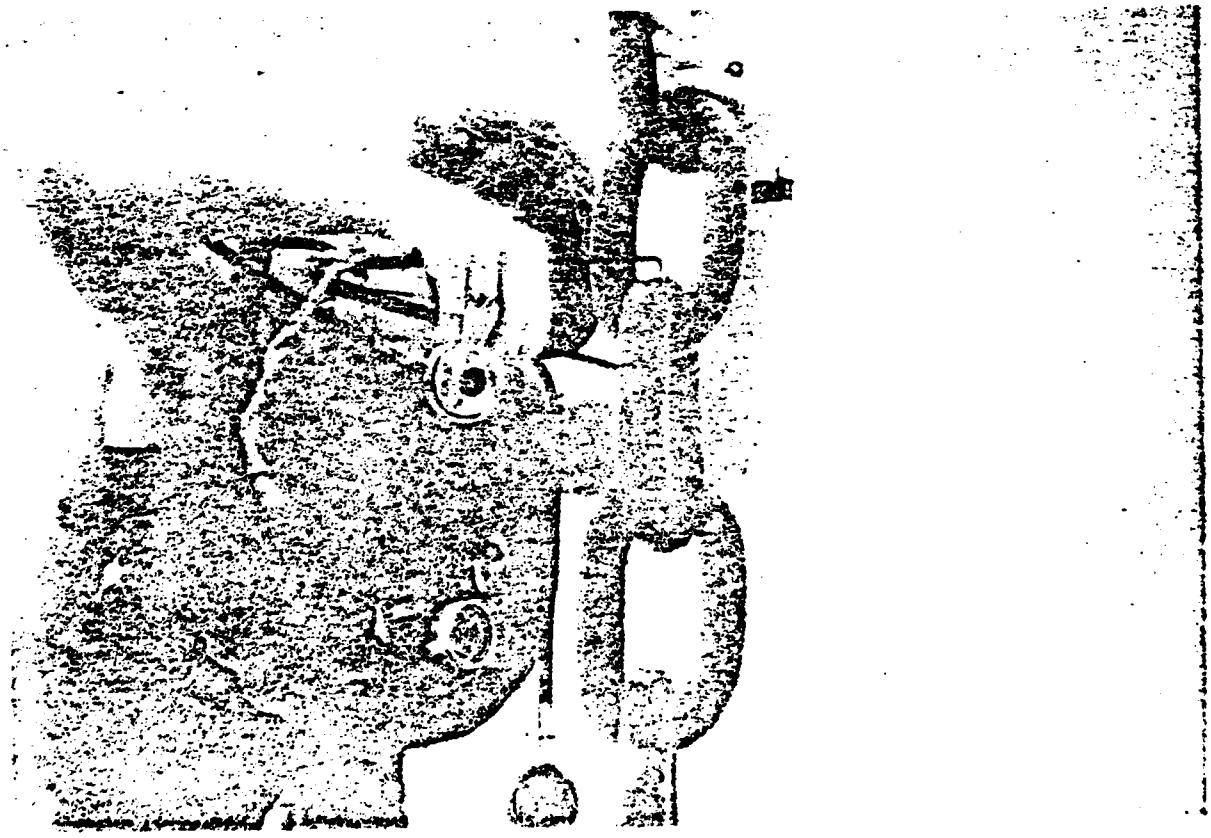
WING DIVIDERS (Figure 1a)

PLEXIGLASS SLATE (Figure 1b)

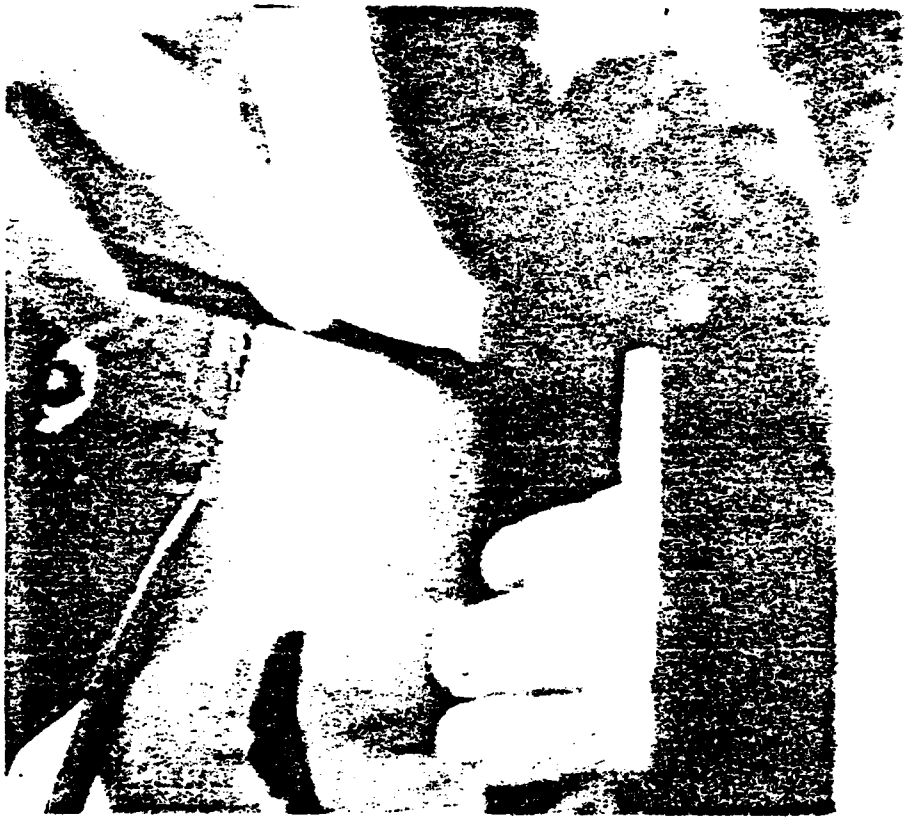


CLEANING LINKS (FIGURE 2)

DOUBLE LINK MEASUREMENT (FIGURE 3)

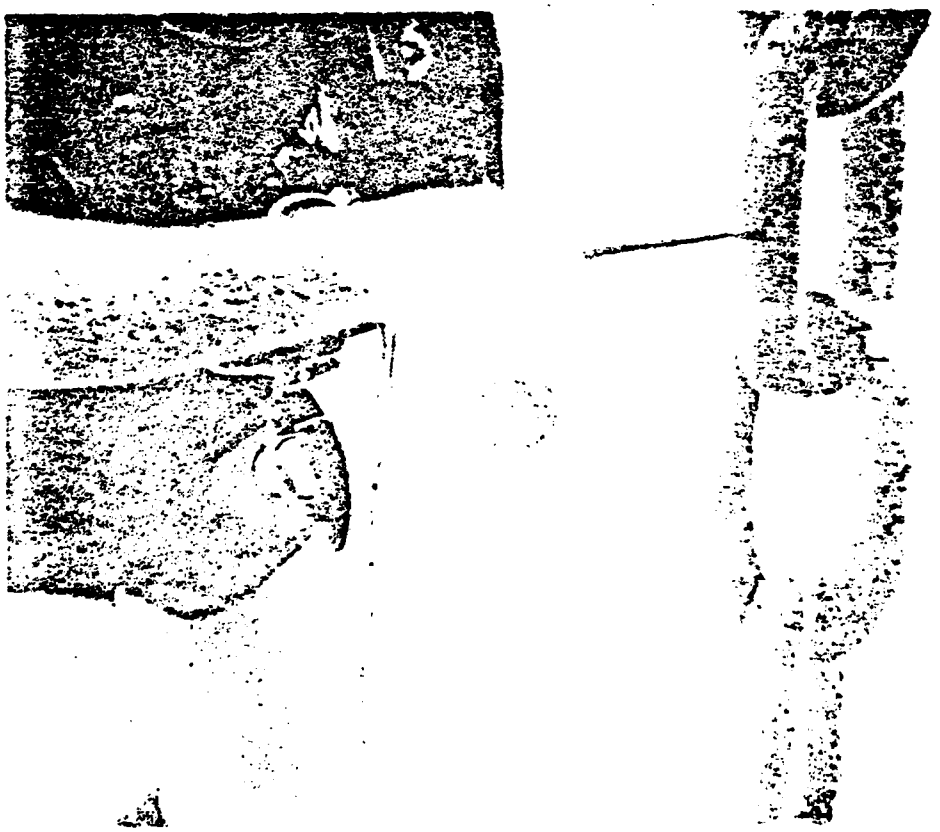


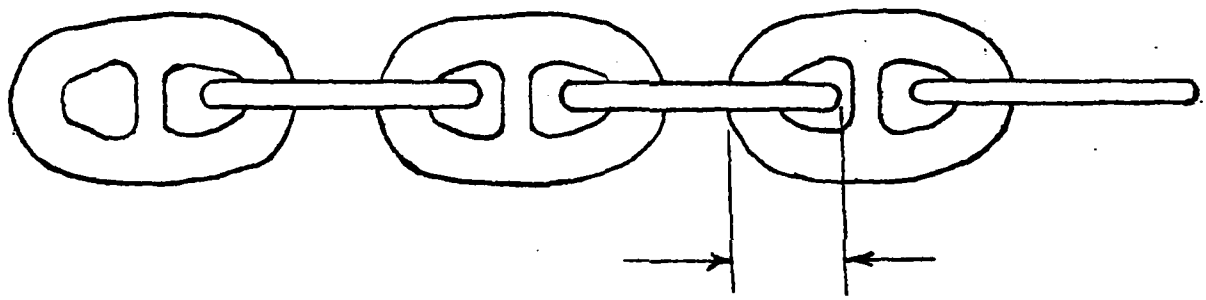
-6-



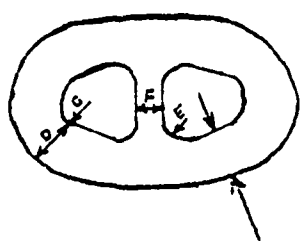
DOUBLE LINK MEASUREMENTS (FIGURE 4)

SINGLE LINK MEASUREMENT (FIGURE 5)





DOUBLE LINK MEASUREMENT



SINGLE LINK MEASUREMENT

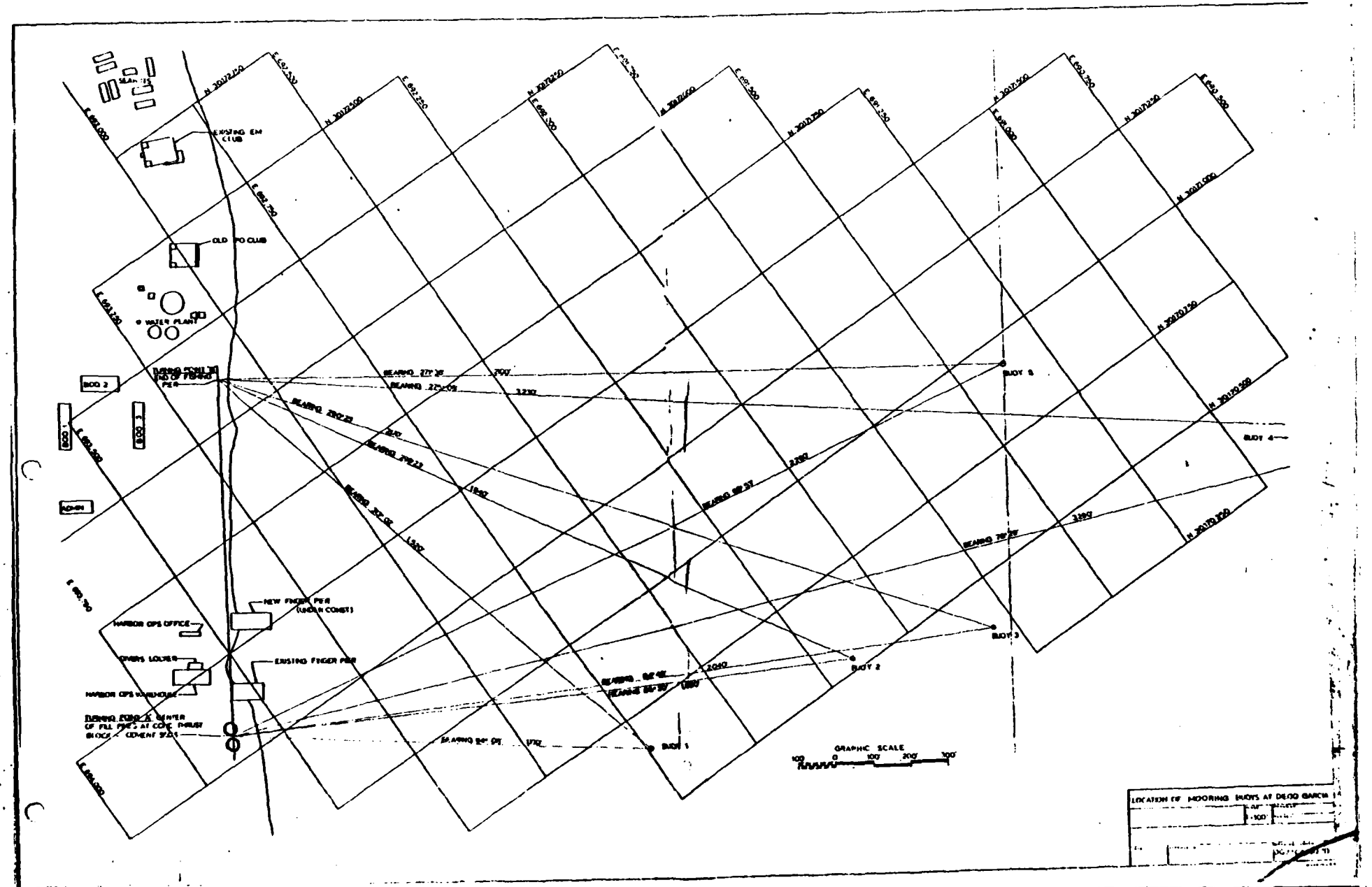
FIGURE 6

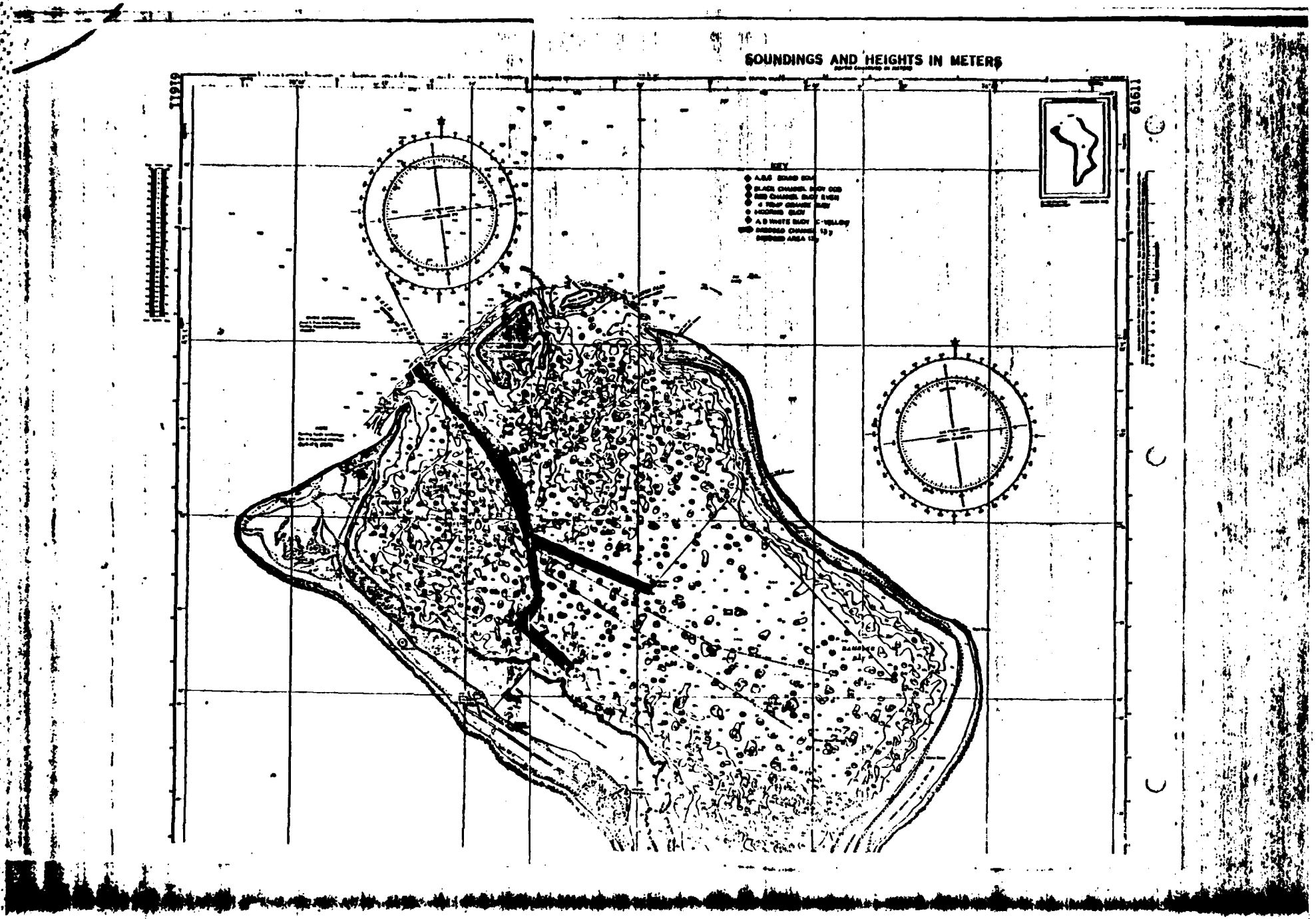
LINK PRIOR TO CLEANING (FIGURE 7)

RECORDING DATA ON SLATE (FIGURE 8)

PIPE DIAMETER MEASUREMENT (FIGURE 9)

BOLT CONNECTION (FIGURE 10)


EXISTING EM CLUB
OLD PO CLUB
WATER PLANT
BOD 2
BOD 1
BOD 3
ADMIN
NEW FINGER PIER (UNDER CONST)
HARBOR OPS OFFICE
SPARS LOCKER
EXISTING FINGER PIER
HARBOR OPS WAREHOUSE
BUOY 1
BUOY 2
BUOY 3
BUOY 4
BUOY 5
GRAPHIC SCALE
0 100 200 300


SOUNDINGS AND HEIGHTS IN METERS
11919
61611
KEY

REFERENCES

1. Commander, Pacific Division, Naval Facilities Engineering Command MEMO SER 3903, of 6 June 1977.

2. Naval Facilities Engineering Command, MO-124: "Mooring Maintenance" December 1973.

APPENDIX "B"

(1) Drawing of typical Mooring Basin Marker.

(2) Drawing of typical Channel Marker

(3) Drawings of Cement Ship Mooring

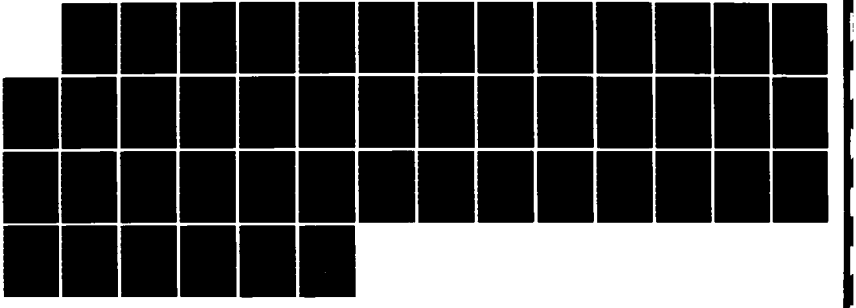
(4) Drawing of Temp. P.O.L.. Mooring

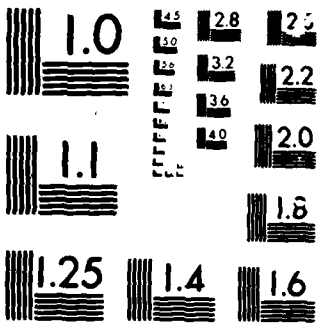
(5) Drawings of Perm. P.O.L.. Mooring

(6) Drawings of Lone Buoy.

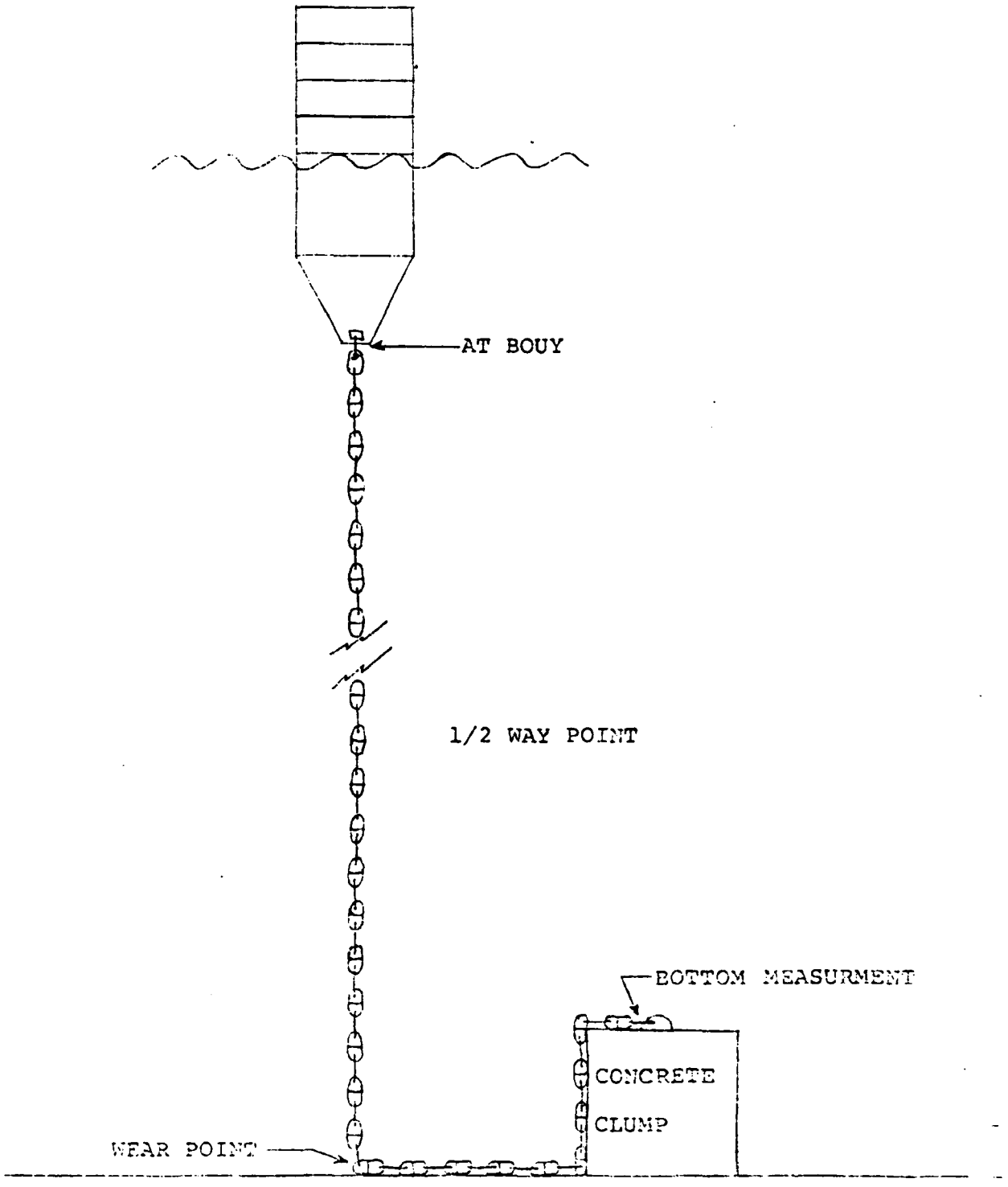
AD-A167 232 PIER BUOY MOORING PROJECT AND MAINTENANCE TO EXISTING MOORING DIEGO GARCI..(U) NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON DC CHESAPEAKE.. K COOPER JAN 88 2/2

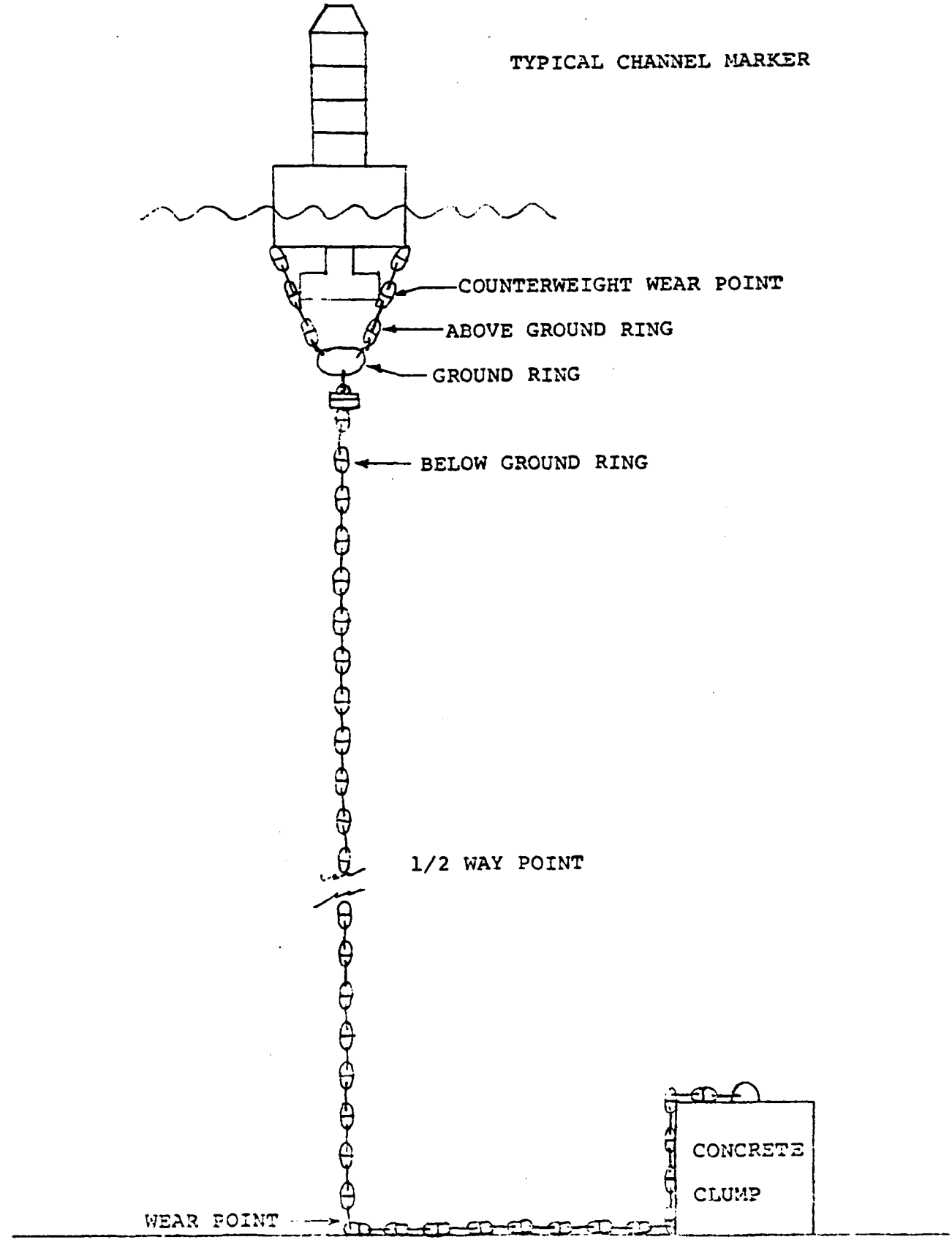
UNCLASSIFIED CHES/NAVFAC-FPO-1-88(3) F/G 13/2 NL





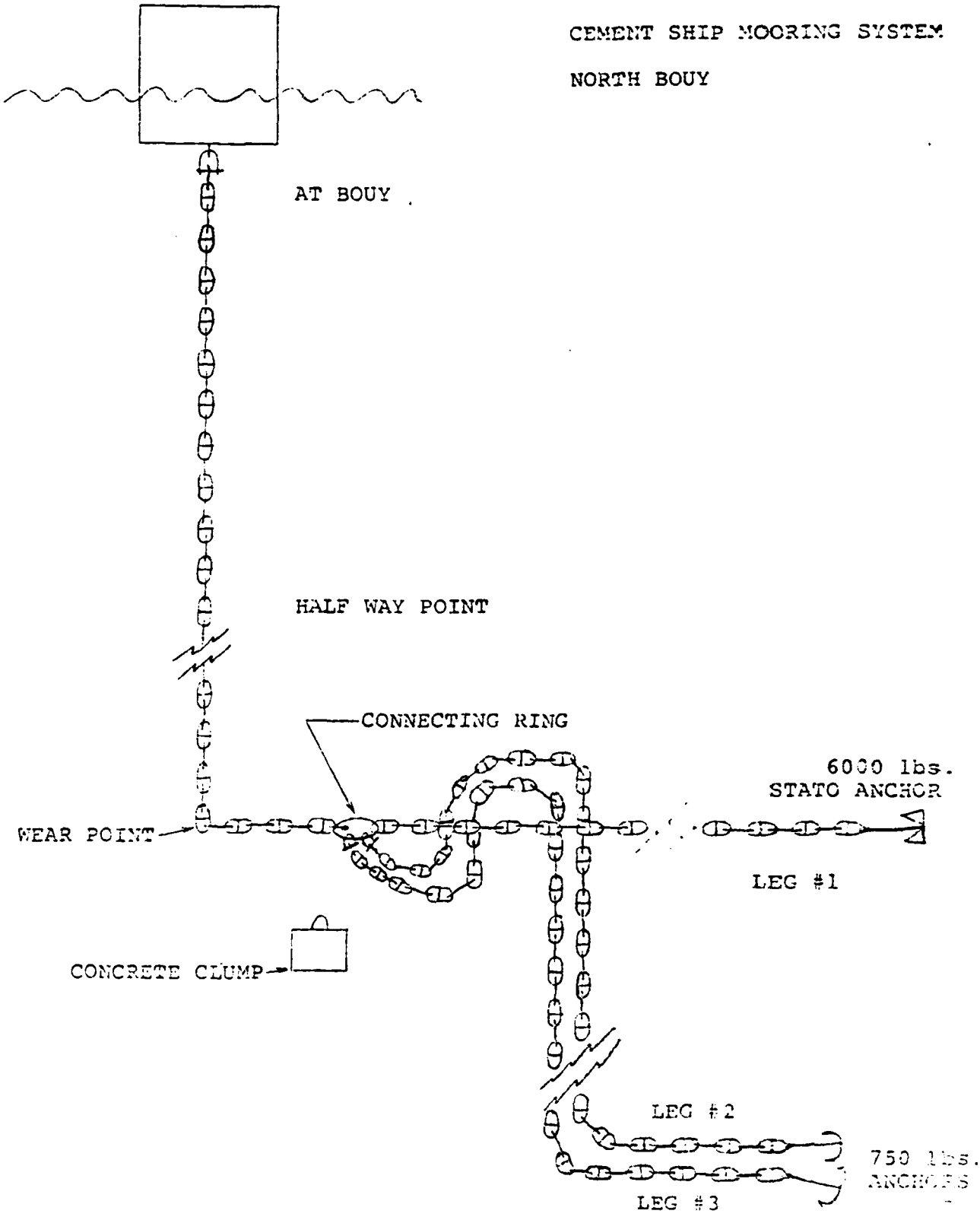
TYPICAL HARBOR BOUY

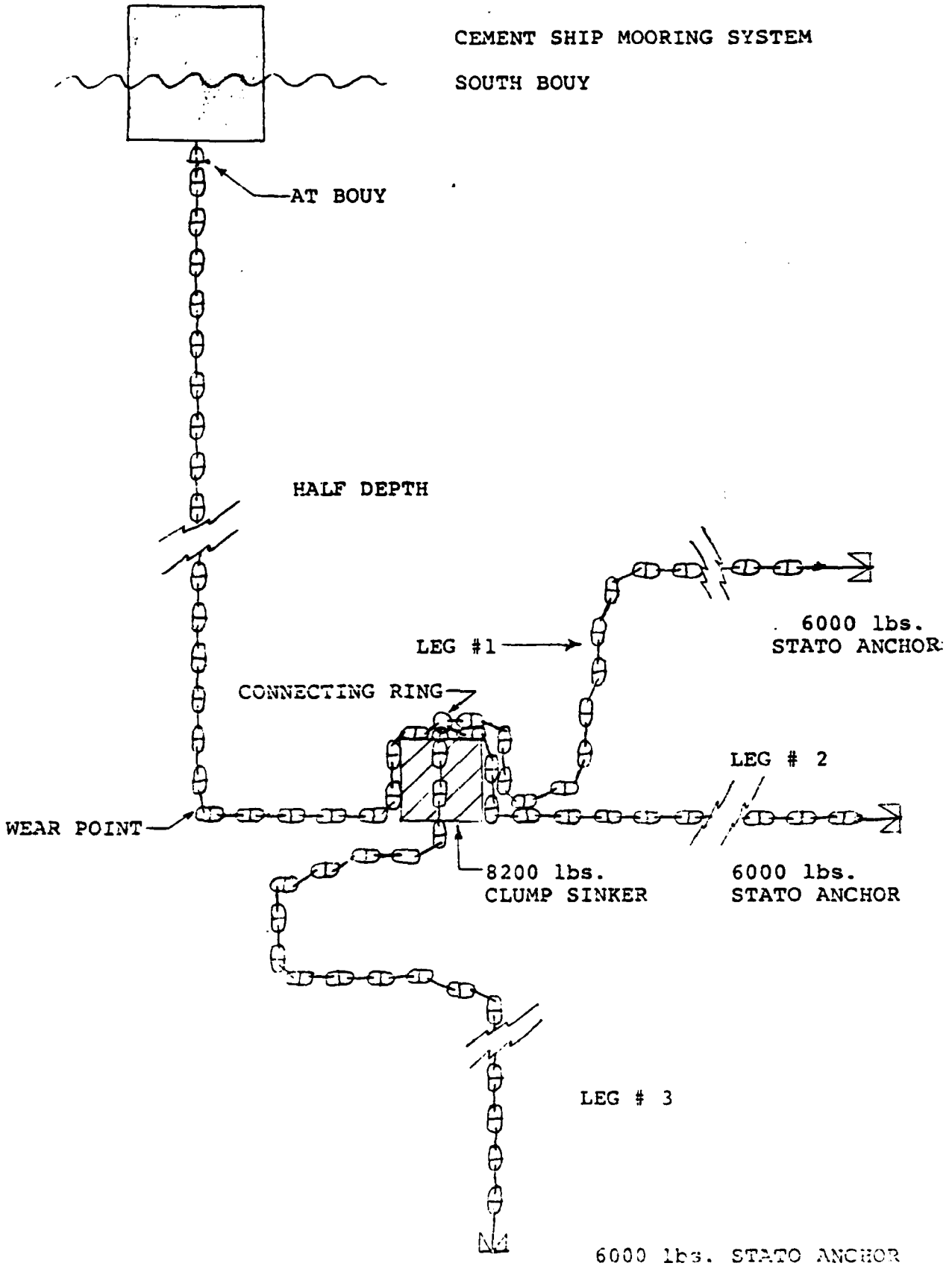



TYPICAL CHANNEL MARKER
COUNTERWEIGHT WEAR POINT
ABOVE GROUND RING
GROUND RING
BELOW GROUND RING
1/2 WAY POINT
CONCRETE
CLUMP
WEAR POINT

CEMENT SHIP MOORING SYSTEM

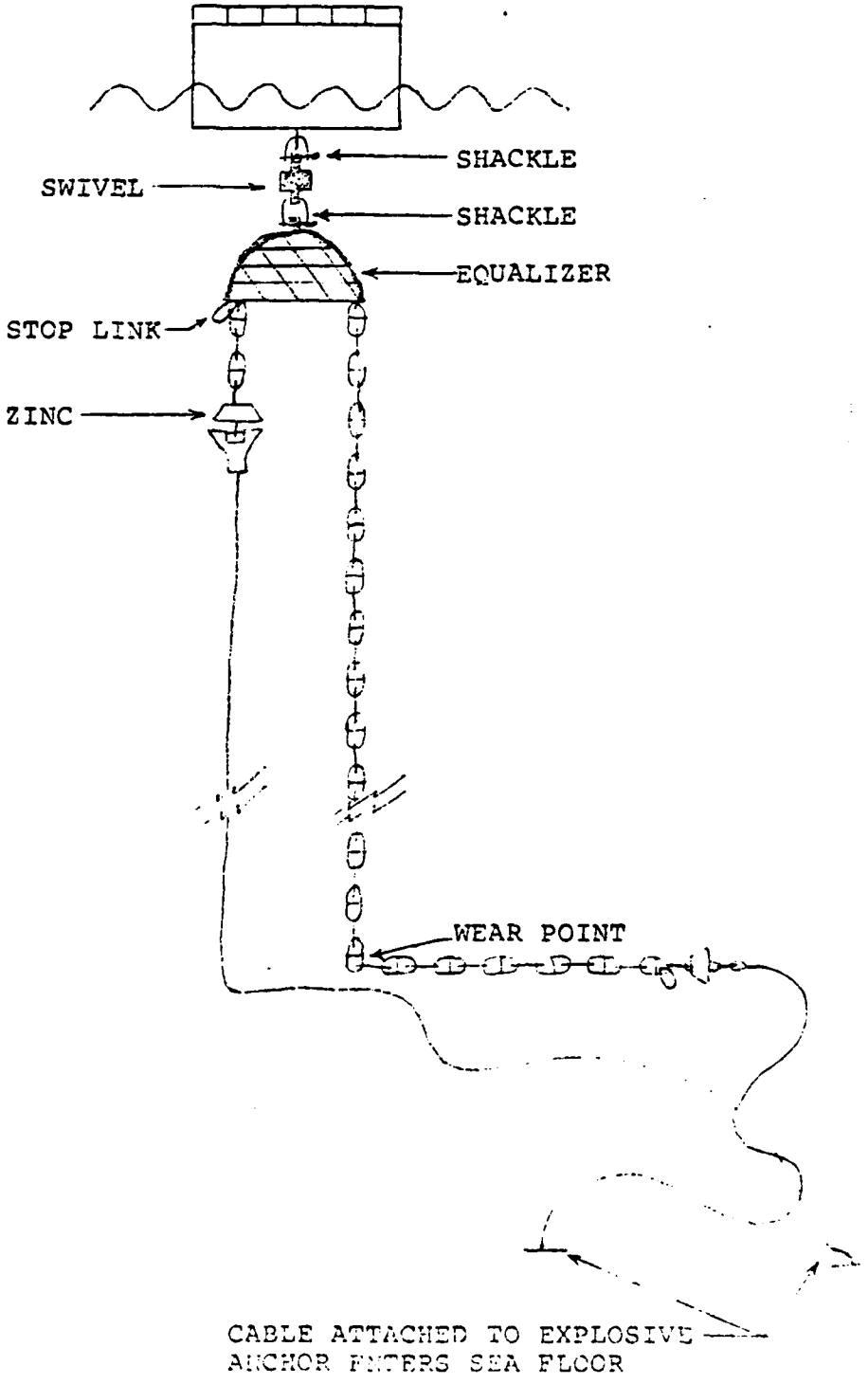
NORTH BOUY




CEMENT SHIP MOORING SYSTEM
SOUTH BOUY
AT BOUY
HALF DEPTH
LEG #1
6000 lbs.
STATO ANCHOR
CONNECTING RING
LEG # 2
WEAR POINT
8200 lbs.
CLUMP SINKER
6000 lbs.
STATO ANCHOR
LEG # 3
6000 lbs. STATO ANCHOR

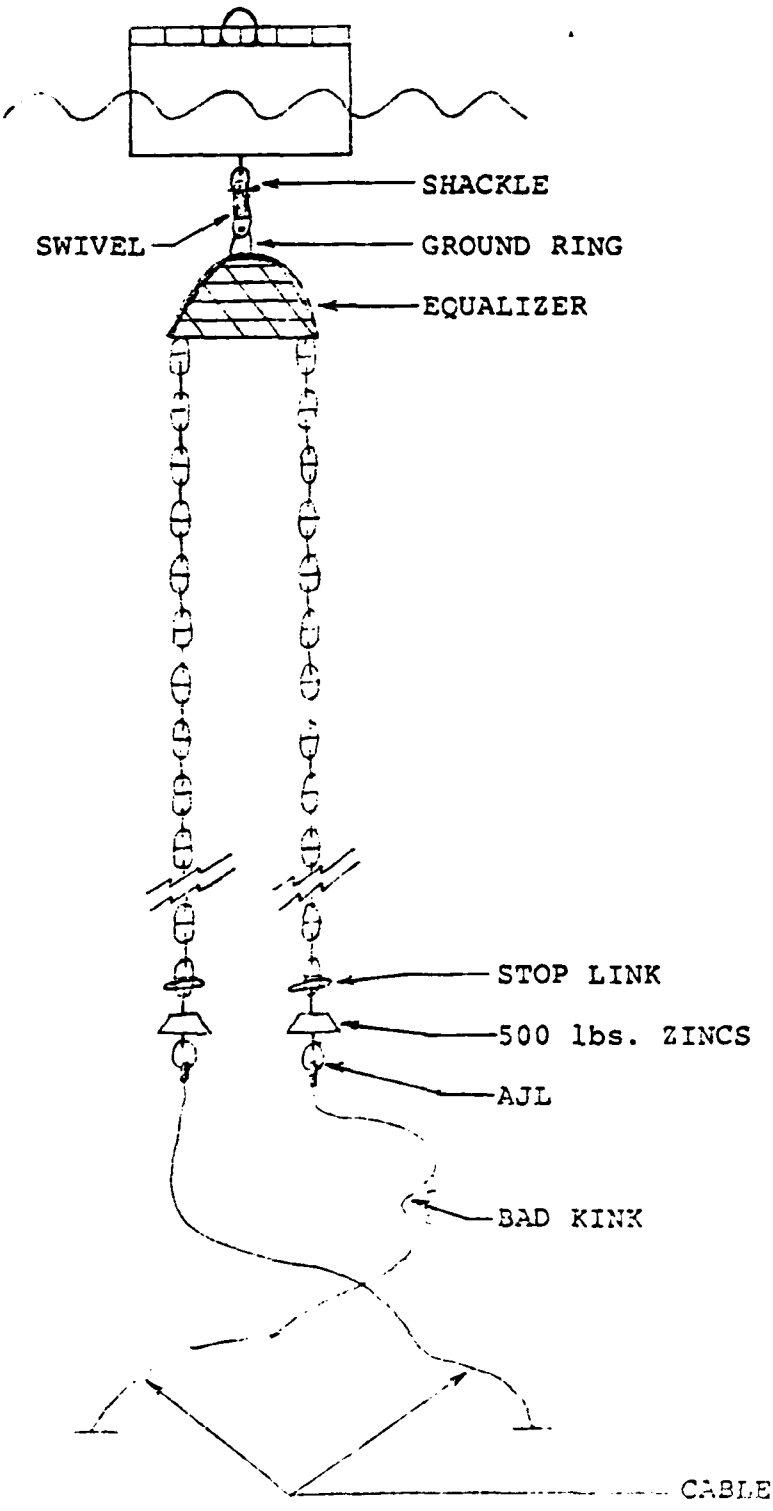
TEMPORARY POL MOORING SYSTEM

NORTH BOUY



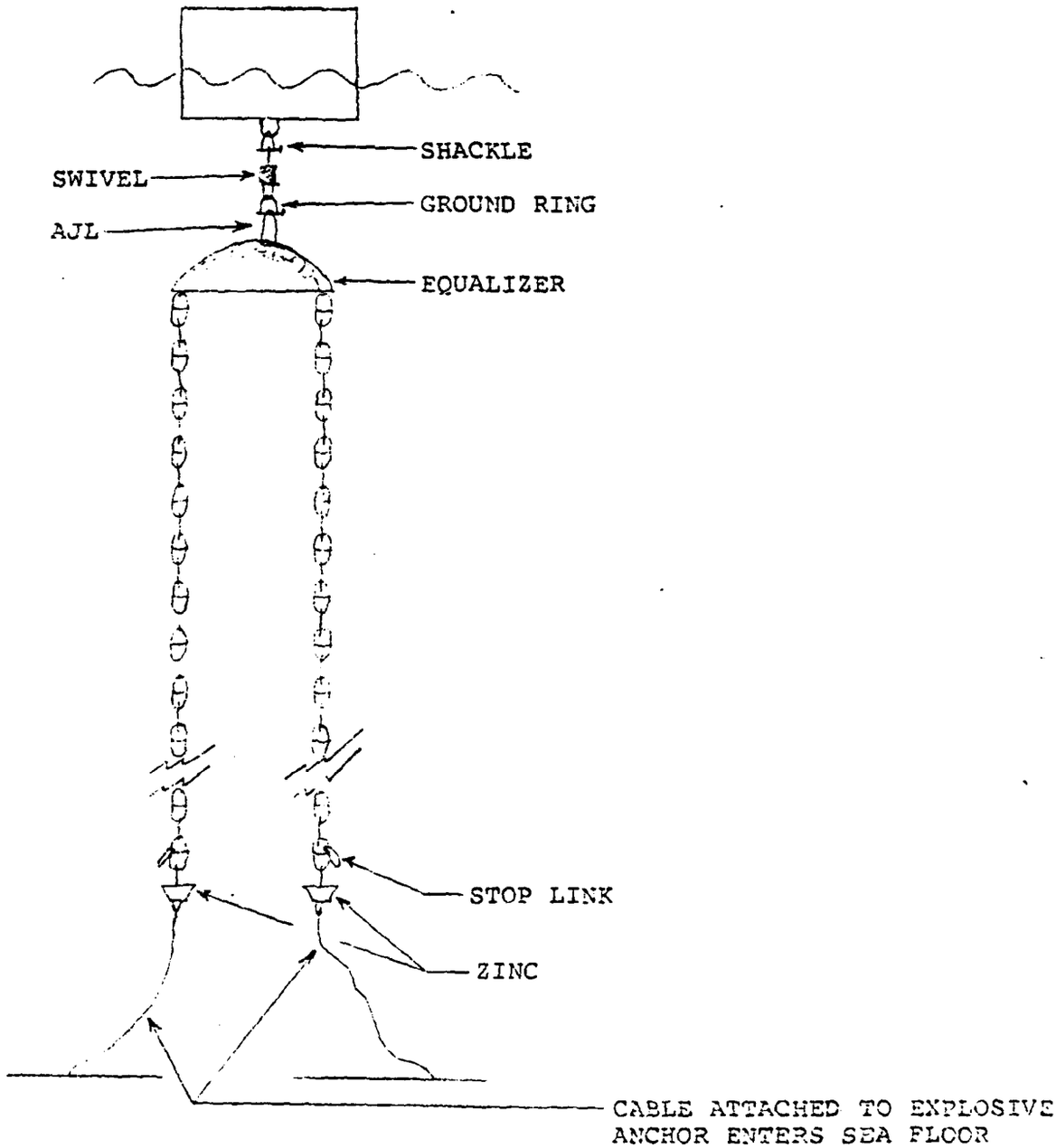
TEMPORARY POL MOORING SYSTEM

SOUTH BOUY



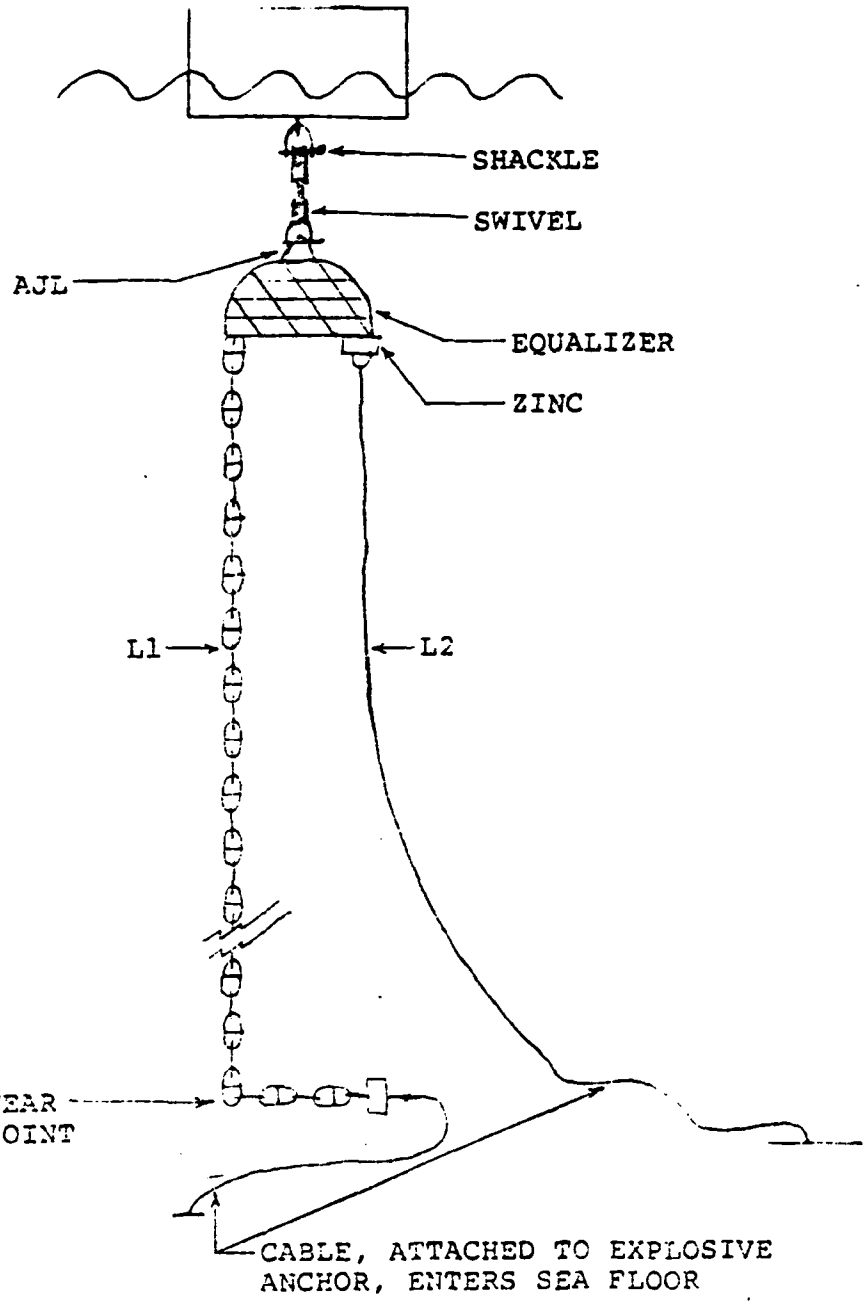
TEMPORARY POL MOORING SYSTEM

NORTHEAST

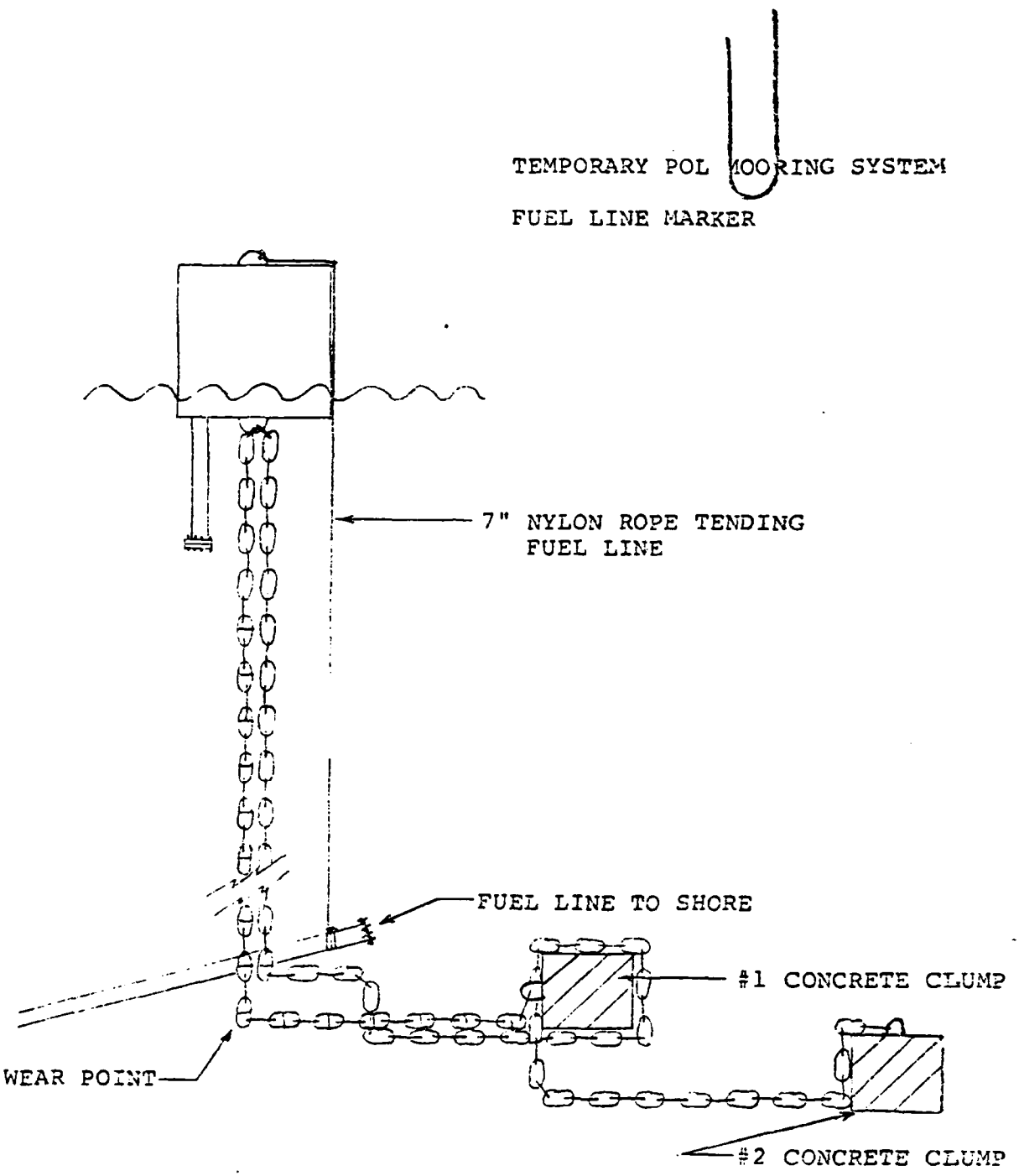


TEMPORARY POL MOORING SYSTEM

NORTHWEST

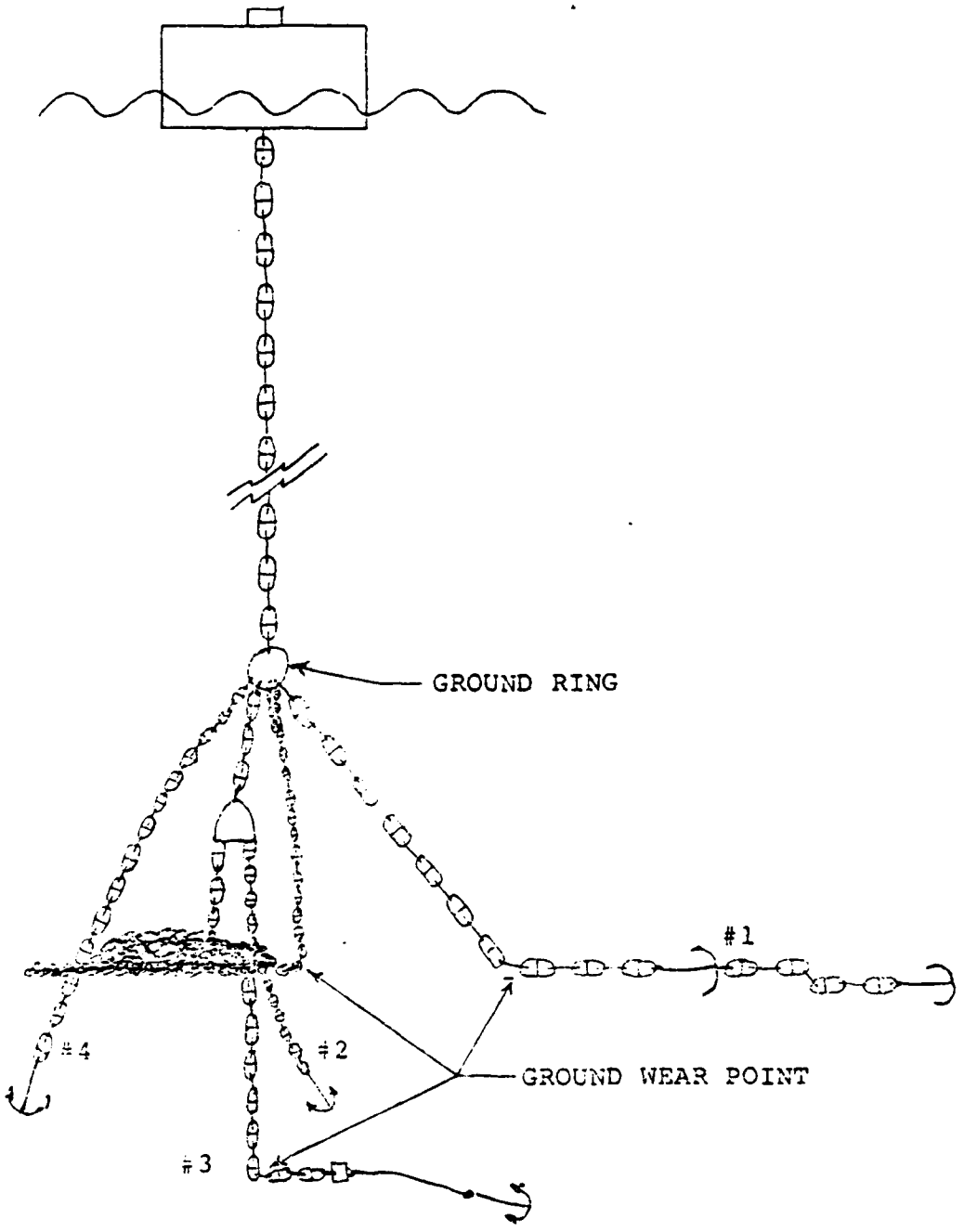


TEMPORARY POL MOORING SYSTEM



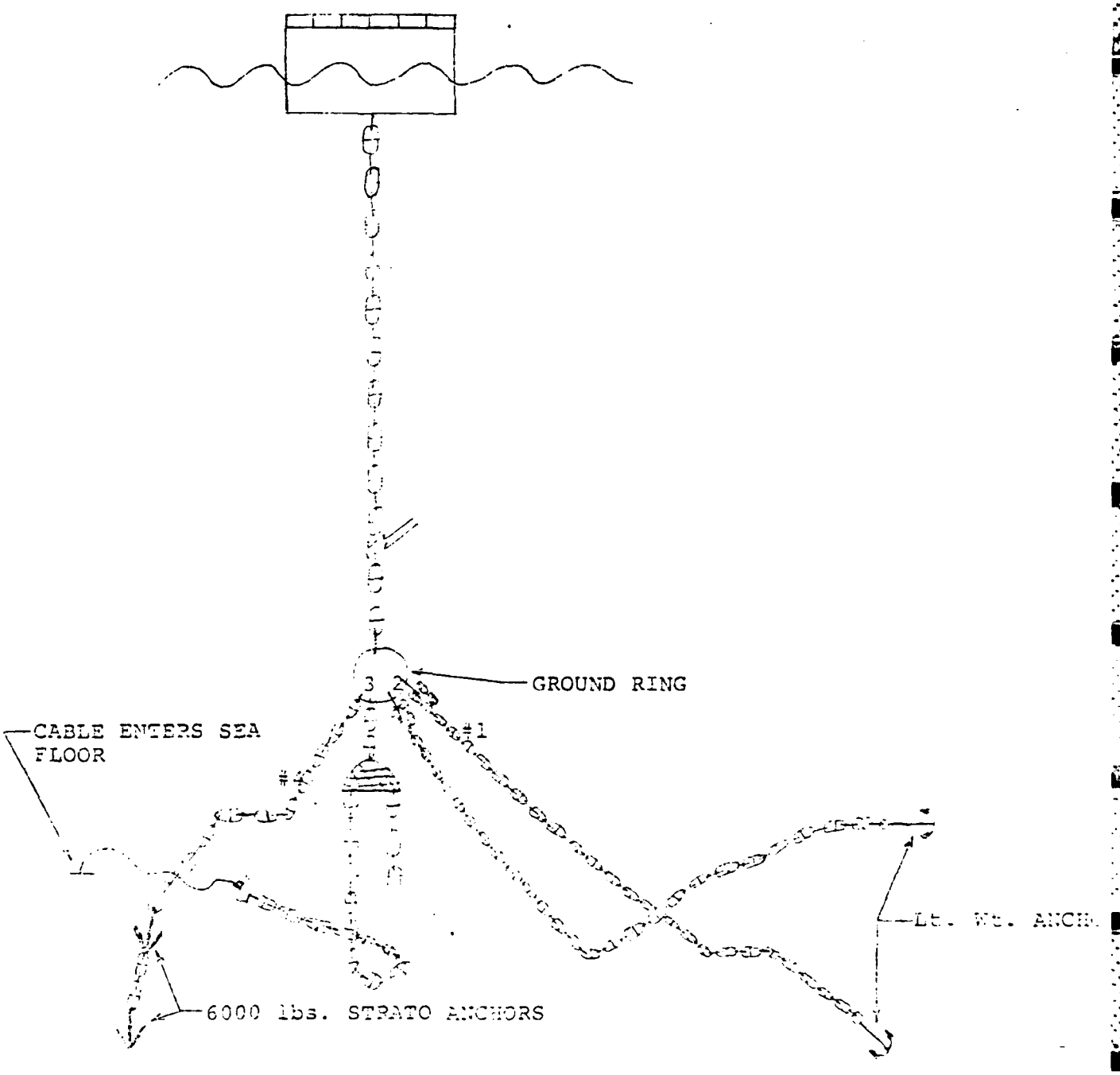
PERMANENT POL MOORING SYSTEM

NORTH BOUY



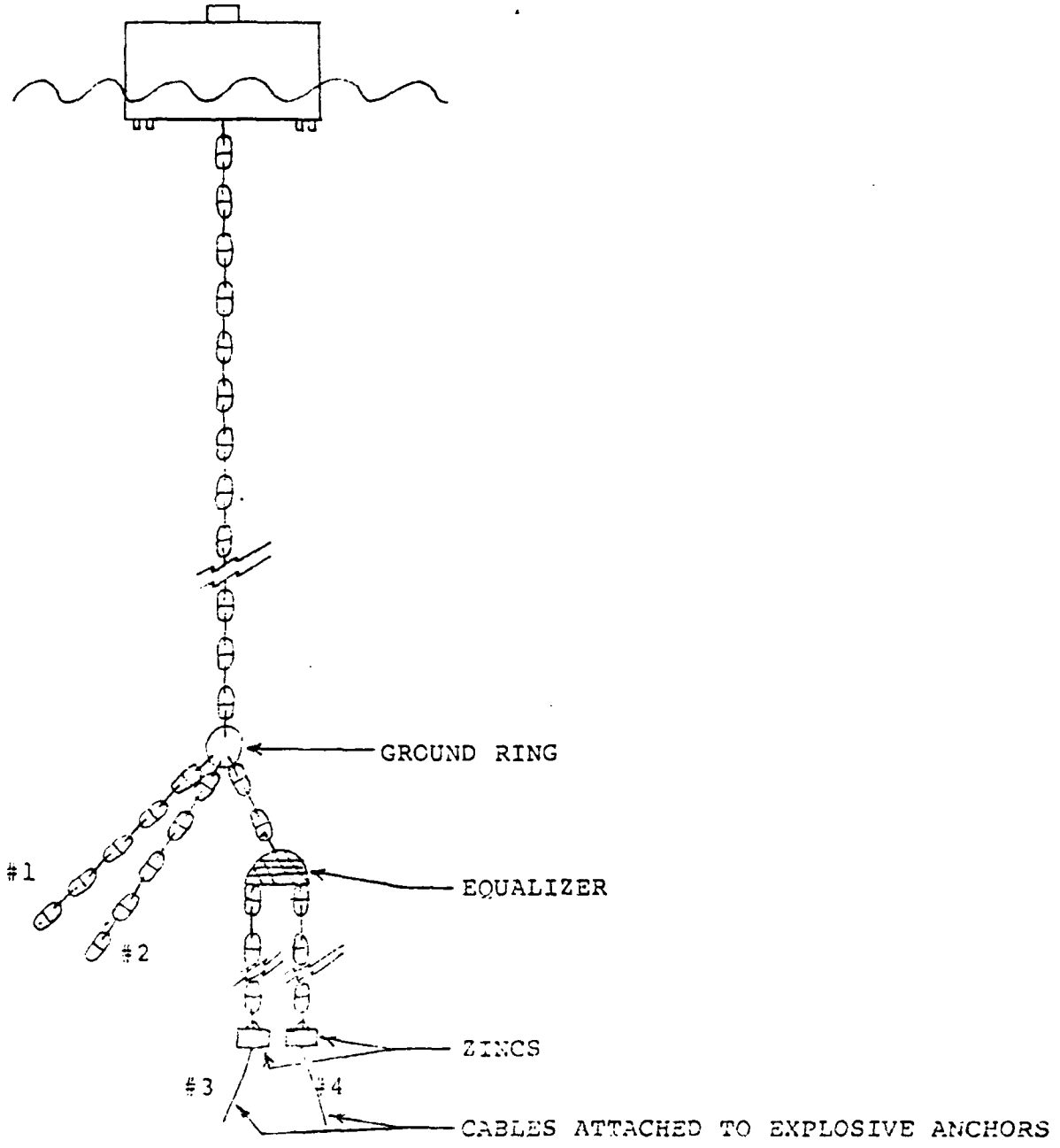
PERMANENT POL MOORING SYSTEM

SOUTH BOUY



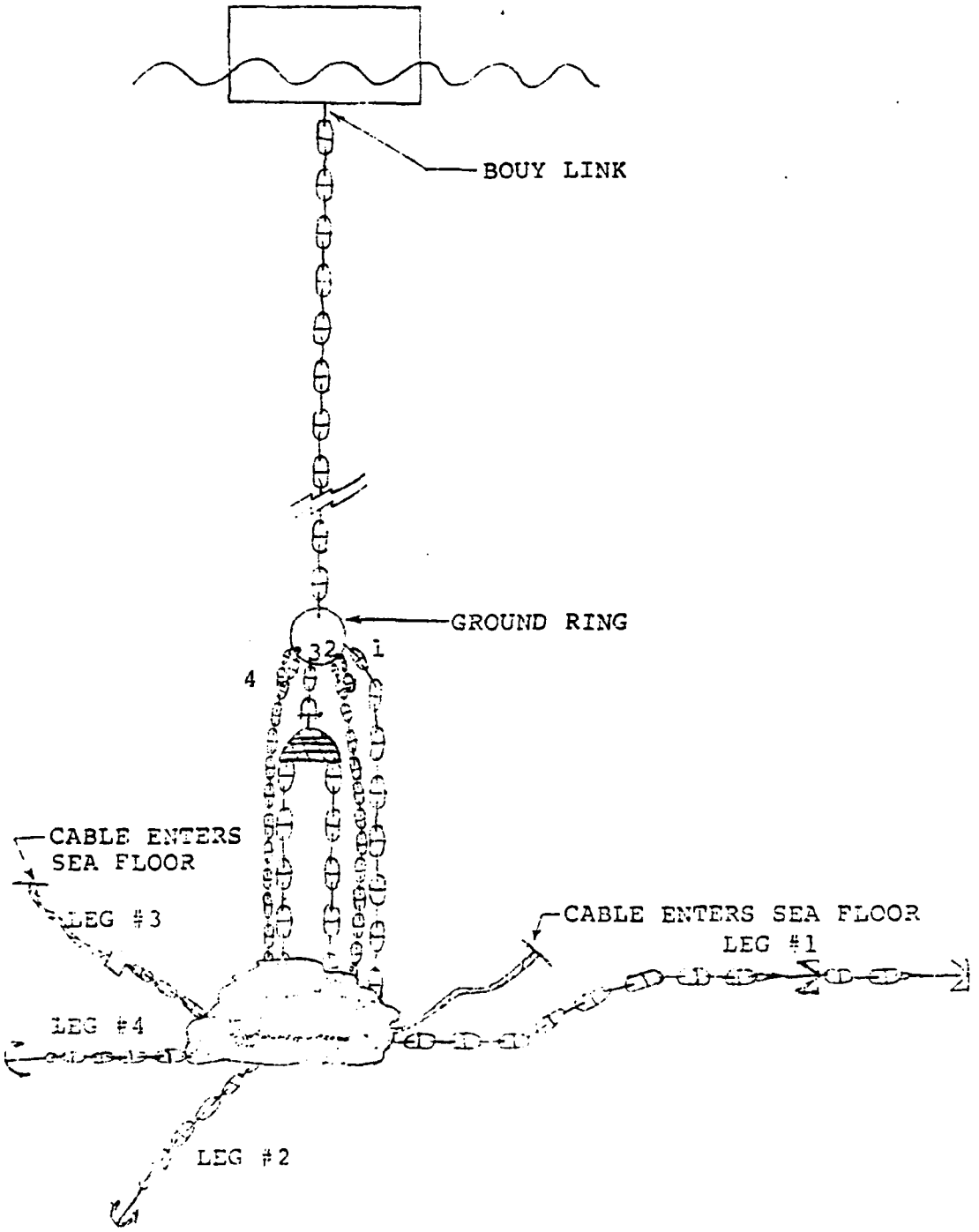
PERMANENT POL MOORING SYSTEM

EAST BOUY

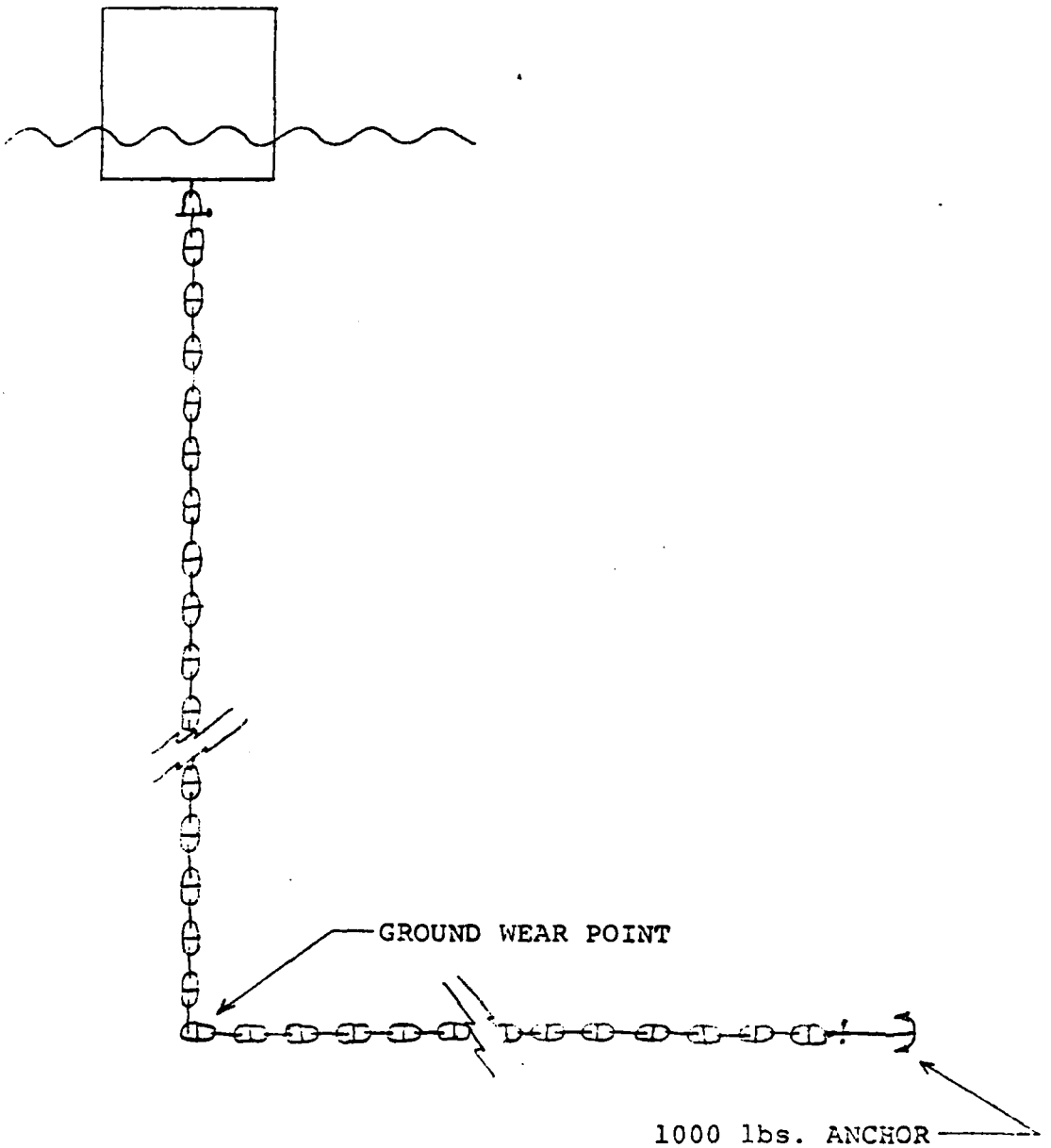


PERMANENT POL MOORING SYSTEM

WEST BOUY



LONE BOUY



APPENDIX "C"

Technical note N-1446. The C.E.L. 100k Propellant Anchor Utilization for Tanker Mooring in soft coral at Diego Garcia.

HARBOR BUOY "A"

DATE: AUG 77

BUOY #2C-75009

Water Depth 85 feet

ALL MEASUREMENTS IN INCHES

		1	2	3
CLUMP U BOLT		1 1/2"	1 1/2"	1 1/2"
AT CLUMP	SL	7/8"	7/8"	7/8"
	DL	1 3/4"	1 3/4"	1 3/4"
AT WEAR POINT	SL	11/16"	11/16"	11/16"
	DL	1 3/8"	1 3/8"	1 3/8"
1/2 WAY	SL	13/16"	13/16"	13/16"
	DL	1 5/8"	1 5/8"	1 5/8"
AT BUOY	SL	11/16"	11/16"	11/16"
	DL	1 3/8"	1 3/8"	1 3/8"
A.J.L.	SL	15/16"		

HARBOR BUOY "B"

DATE: AUG 77

BUOY # 2C-75-12

WATER DEPTH 80'

		1	2	3
CLUMP U BOLT		2"	2"	2"
AT CLUMP	SL	3/4"	1"	3/4"
	DL	1 1/2"	1 1/2"	1 1/2"
AT WEAR POINT	SL	7/8"	7/8"	7/8"
	DL	1 5/8"	1 5/8"	1 5/8"
1/2 WAY	SL	3/4"	3/4"	3/4"
	DL	1 1/2"	1 1/2"	1 1/2"
AT BUOY	SL	5/8"	5/8"	5/8"
	DL	1 5/8"	1 5/8"	1 5/8"
A.J.L.	SL	3/4"		

HARBOR BUOY "C"

DATE: AUG 77

BUOY # 2C-75-24

WATER DEPTH 90'

		1	2	3
CLUMP U BOLT		CLUMP UPSIDE DOWN		
AT CLUMP	SL	15/16"	15/16"	15/16"
	DL	1 5/8"	1 5/8"	1 5/8"
AT WEAR POINT	SL	15/16"	15/16"	7/8"
	DL	1 9/16"	1 9/16"	1 9/16"
1/2 WAY	SL	7/8"	7/8"	15/16"
	DL	1/12"	1 9/16"	1 9/16"
AT BUOY	SL	11/16"	11/16"	11/16"
	DL	1 7/8"	1 7/8"	1 7/8"
A.J.L.	SL	1 1/2"		

CHANNEL MARKER 1

DATE: AUG 77

BUOY #6-73-09

WATER DEPTH 50'

		1	2	3
CLUMP U BOLT		CLUMP UPSIDE DOWN		
AT CLUMP	SL	1 1/4"	1 1/4"	1 1/4"
	DL	2 5/8"	2 5/8"	2 5/8"
AT WEAR POINT	SL	1 3/16"	1 3/16"	1 3/16"
	DL	2 1/4"	2 1/8"	2 1/8"
1/2 WAY	SL	1 7/16"	1 7/16"	1 7/16"
	DL	2 5/8"	2 5/8"	2 5/8"
GROUND RING	SL	1 1/8"	1 1/8"	1 1/8"
	DL	1 3/4"	1 3/4"	
ABOVE GROUND RING	SL	1 3/8"	1 3/8"	1 3/8"
	DL	2 5/8"	2 5/8"	2 5/8"
COUNTERWEIGHT WEAR POINT		1 1/4"		

CHANNEL MARKER 2

DATE: AUG 77

BUOY #6-73-08

WATER DEPTH 50'

		1	2	3
CLUMP U BOLT		1 7/8"	CLUMP ON SIDE	
AT CLUMP	SL	1 7/16"	1 7/16"	1 7/16"
	DL	3 1/8"	3 1/8"	3 1/8"
AT WEAR POINT	SL	1 1/4"	1 3/16"	1 1/8"
	DL	2 5/8"	2 5/8"	2 5/8"
1/2 WAY	SL	1 3/8"	1 3/8"	1 3/8"
	DL	2 3/4"	2 3/4"	2 3/4"
GROUND RING		1 3/8"	1 3/8"	1 3/8"
ABOVE GROUND RING	SL	7/8"	3/4"	1/2"
	DL	1 7/16"	1 1/4"	1 1/4"
COUNTER WEIGHT WEAR POINT		3/4"		

CHANNEL MARKER 3

DATE: AUG 77

BUOY # N/A

WATER DEPTH 60'

1 2 3

BUOY BROKE LOOSE AND NEVER FOUND. HAS 24" BLACK HARD FLOAT TO MARK SPOT.

CHANNEL MARKER 4

DATE: AUG 77

BUOY # N/A

WATER DEPTH 60'

BUOY BROKE LOOSE AND NEVER FOUND. HAS 24" RED HARD FLOAT TO MARK SPOT.

CHANNEL MARKER 6

DATE: AUG 77

BUOY #6-73-05

WATER DEPTH 80'

		1	2	3
CLUMP U BOLT		CLUMP UPSIDE DOWN		
AT CLUMP	SL	1 1/2"	1 1/2"	1 5/16"
	DL	2 13/16"	2 13/16"	2 13/16"
AT WEAR POINT	SL	1/5/16"	1 5/16"	1 5/16"
	DL	2 3/8"	2 3/8"	2 3/8"
1/2 WAY	SL	1 3/8"	1 3/8"	1 5/16"
	DL	2 7/8"	2 7/8"	2 3/4"
GROUND RING		1 9/16"	1 9/16"	1 9/16"
ABOVE GROUND RING	SL	15/16"	15/16"	15/16"
	DL	1 13/16"	1 13/16"	1 13/16"
COUNTERWEIGHT WEAR POINT		13/16"		

CHANNEL MARKER 7

DATE: AUG 77

BUOY #6-73-16

WATER DEPTH 70'

		1	2	3
CLUMP U BOLT		1 7/8"	1 7/8"	1 7/8"
AT CLUMP	SL	1 1/2"	1 1/2"	1 1/2"
	DL	2 3/4"	2 3/4"	2 3/4"
AT WEAR POINT	SL	1 1/2"	1 1/2"	1 1/2"
	DL	2 3/4"	2 3/4"	2 3/4"
1/2 WAY	SL	1 1/2"	1 1/2"	1 1/2"
	DL	2 7/8"	2 7/8"	2 7/8"
GROUND RING		NO GROUND RING HAS SHACKEL		1 1/2"
ABOVE GROUND RING (SHACKEL)	SL	1 1/8"	1 1/8"	1 1/8"
	DL	3"	3"	3"
COUNTERWEIGHT WEAR POINT		L 1/8"		

CHANNEL MARKER 8

DATE: AUG 77

BUOY #6-73-10

WATER DEPTH 70'

		1	2	3
CLUMP U BOLT		1 3/4"	1 3/4"	1 3/4"
AT CLUMP	SL	1 9/16"	1 1/2"	1 1/2"
	DL	3 1/8"	3"	3"
AT WEAR POINT	SL	1 1/4"	1 1/4"	1 1/4"
	DL	2 1/2"	2 1/2"	2 1/2"
1/2 WAY	SL	1 1/2"	1 1/2"	1 1/2"
	DL	2 3/4"	2 3/4"	2 3/4"
GROUND RING		1 3/4"	1 3/4"	1 3/4"
ABOVE GROUND RING	SL	1"	1"	1"
	DL	1 1/2"	1 1/2"	1 1/2"
COUNTERWEIGHT WEAR POINT		7/8"		

CHANNEL MARKER 9

DATE: AUG 77

BUOY #6-73-03

WATER DEPTH 80'

		1	2	3
CLUMP U BOLT		1 7/8"	1 7/8"	1 7/8"
AT CLUMP	SL	1 5/8"	1 1/2"	1 1/2"
	DL	2 7/8"	3"	3"
AT WEAR POINT	SL	1 1/4"	1 1/4"	1 1/4"
	DL	2 3/4"	2 3/4"	2 3/4"
1/2 WAY	SL	1 1/2"	1 1/2"	1 1/2"
	DL	2 3/4"	2 3/4"	2 3/4"
GROUND RING		1 3/4"	1 3/4"	1 3/4"
ABOVE GROUND RING	SL	1"	1"	1"
	DL	2 3/4"	2 3/4"	2 3/4"
COUNTERWEIGHT WEAR POINT		7/8"		

CHANNEL MARKER 10

DATE: AUG 77

BUOY #6-73-02

WATER DEPTH 90'

		1	2	3
CLUMP U BOLT		CLUMP UNSIDE DOWN		
AT CLUMP	SL	1 7/16"	1 7/16"	1 7/16"
	DL	2 7/8"	2 7/8"	2 7/8"
AT WEAR POINT	SL	1 3/16"	1 3/16"	1 3/16"
	DL	2 5/8"	2 5/8"	2 5/8"
1/2 WAY	SL	1 3/8"	1 3/8"	1 3/8"
	DL	2 3/4"	2 3/4"	2 3/4"
GROUND RING		1 9/16"	1 5/8"	1 5/8"
ABOVE GROUND RING	SL	1 1/16"	1 1/16"	1 1/16"
	DL	2"	2"	2 1/16"
COUNTERWEIGHT WEAR POINT		5/8"		

CHANNEL MARKER 11

DATE: AUG 77

BUOY #6-73-07

WATER DEPTH 80'

		1	2	3
CLUMP U BOLT		2 9/16"	2 9/16"	2 9/16"
AT CLUMP	SL	1 9/16"	1 9/16"	1 9/16"
	DL	2 3/4"	2 3/4"	2 3/4"
AT WEAR POINT	SL	1 5/16"	1 5/16"	1 5/16"
	DL	2 5/8"	2 5/8"	2 5/8"
1/2 WAY	SL	1 1/2"	1 1/2"	1 1/2"
	DL	2 7/8"	2 7/8"	2 7/8"
GROUND RING		1 5/8"	1 5/8"	1 5/8"
ABOVE GROUND RING	SL	1 1/16"	1 1/16"	1 1/16"
	DL	2 3/16"	2 3/16"	2 3/16"
COUNTERWEIGHT WEAR POINT		11/16"		

CHANNEL MARKER 12

DATE: AUG 77

BUOY #6-73-14

WATER DEPTH 90'

		1	2	3
CLUMP U BOLT		CLUMP UPSIDE DOWN		
AT CLUMP	SL	1 7/16"	1 7/16"	1 7/16"
	DL	2 13/16"	2 13/16"	2 13/16"
AT WEAR POINT	SL	1 3/16"	1 3/16"	1 3/16"
	DL	2 7/16"	2 7/16"	2 7/16"
1/2 WAY	SL	1 3/8"	1 3/8"	1 3/8"
	DL	2 13/16"	2 13/16"	2 13/16"
GROUND RING		1 5/8"	1 5/8"	1 5/8"
ABOVE GROUND RING	SL	1 3/16"	1 3/16"	1 3/16"
	DL	2 7/16"	2 7/16"	2 7/16"
COUNTERWEIGHT WEAR POINT		7/8"		

CHANNEL MARKER 13

DATE: AUG 77

BUOY #6-73-11

WATER DEPTH 50'

		1	2	3
CLUMP U BOLT		1 7/8"	1 7/8"	1 7/8"
AT CLUMP	SL	1 1/2"	1 1/2"	1 1/2"
	DL	2 7/8"	2 7/8"	2 7/8"
AT WEAR POINT	SL	1 5/16"	1 5/16"	1 5/16"
	DL	2 5/8"	2 5/8"	2 5/8"
1/2 WAY	SL	1 3/8"	1 3/8"	1 3/8"
	DL	2 7/8"	2 7/8"	2 7/8"
GROUND RING		1 5/8"	1 5/8"	1 5/8"
ABOVE GROUND RING	SL	15/16"	15/16"	15/16"
	DL	1 3/4"	1 3/4"	1 3/4"
COUNTERWEIGHT WEAR POINT		7/8"		

CHANNEL MARKER 15

DATE: AUG 77

BUOY #6-73-13

WATER DEPTH 50'

		1	2	3
CLUMP U BOLT		CLUMP UPSIDE DOWN		
AT CLUMP	SL	1 7/16"	1 7/16"	1 7/16"
	DL	2 13/16"	2 13/16"	2 13/16"
AT WEAR POINT	SL	1 5/16"	1 5/16"	1 5/16"
	DL	2 5/8"	2 5/8"	2 5/8"
1/2 WAY	SL	1 7/16"	1 7/16"	1 7/16"
	DL	2 13/16"	2 13/16"	2 13/16"
GROUND RING		1 5/8"	1 5/8"	1 9/16"
ABOVE GROUND RING	SL	1 3/16"	1 3/16"	1 3/16"
	DL	2 3/4"	2 3/4"	2 3/4"
COUNTERWEIGHT WEAR POINT		7/8"		

CEMENT SHIP MOORING NORTH

DATE: AUG 77

BUOY # NONE FOUND

WATER DEPTH 45'

		1	2	3
LEG ONE				
AT HEAVY ANCHOR	SL	1 1/8"	1 1/8"	1 1/8"
	DL	2 1/4"	2 1/4"	2 1/4"
AT CONNECTING RING	SL	1 1/8"	1 1/8"	1 1/8"
	DL	2 1/4"	2 1/4"	2 1/4"
LEG TWO AND THREE SAME				
AT LIGHT ANCHOR	SL	1"	1"	1"
	DL	2 1/16"	2 1/16"	2 1/16"
AT CONNECTING RING	SL	1"	1"	1"
	DL	2 1/16"	2 1/16"	2 1/16"
SHACKELS		15/16"	15/16"	15/16"
CONNECTING RING		1 5/8"	1 5/8"	1 5/8"
RISER AT CONNECTING RING	SL	1"	1"	1"
	DL	2"	2"	2"
AT WEAR POINT	SL	3/4"	3/4"	3/4"
	DL	1 5/8"	1 1/2"	1 1/2"
1/2 WAY	SL	1 1/16"	1"	1 1/16"
	DL	1 7/8"	1 13/16"	1 13/16"
AT BUOY	SL	1"	1"	1"
	DL	1 15/16"	1 7/8"	1 7/8"
SHACKLE		1"		

CEMENT SHIP MOORING BUOY SOUTH

DATE: AUG 77

BUOY # NONE FOUND

WATER DEPTH 40'

		1	2	3
LEG ONE				
AT ANCHOR AND CONNECTING RING	SL	1 3/4"	1 3/4"	1 3/4"
	DL	3 1/2"	3 1/2"	3 1/2"
LEG TWO				
AT ANCHOR AND CONNECTING RING	SL	1 3/4"	1 3/4"	1 3/4"
	DL	2 3/8"	2 3/8"	2 3/8"
LEG THREE				
AT ANCHOR AND CONNECTING RING	SL	1 3/4"	1 3/4"	1 3/4"
	DL	3 3/8"	3 3/8"	3 3/8"
CONNECTING RING		2 3/4"	2 3/4"	2 3/4"
SHACKLES		2"	1 3/4"	1 7/8"
RISER				
AT WEAR POINT	SL	1 3/4"	1 3/4"	1 3/4"
	DL	3 3/8"	3 1/4"	3 1/4"
1/2 WAY	SL	1 3/4"	1 3/4"	1 3/4"
	DL	3 7/8"	3 7/8"	3 7/8"
AT BUOY	SL	1 3/4"	1 3/4"	1 3/4"
	DL	3 1/2"	3 1/2"	3 1/2"
SHACKLE		1 7/8"		

TEMP P.O.L. NORTH

DATE: AUG 77

BUOY # NONE FOUND

WATER DEPTH 70'

ALL MEASUREMENTS THE SMAE AS EAST BUOY. SPECIAL NOTE: THE ANCHOR LEG THAT HAS THE ZINC SUPPENDED AT EQUALIZER SOUNDS HOLLOW AROUND BOTTOM AND THE COTTER PIN FOR THE POURED SOCKET IS MISSING. ON THE OTHER LEG THERE ARE THREE KINKS WITH EACH ONE HAVING THREE TO FOUR WIRE STRANDS BROKEN. NO ZINCS ONE EQUALIZER.

TEMP P.O.L. SOUTH

DATE:. AUG 77

BUOY # NONE FOUND

WATER DEPTH 65'

ALL MEASUREMENTS ARE THE SAME AS FOR EAST BUOY, SPECIAL NOTE: NO ZINCS ON EQUALIZER. ONE OF THE ANCHOR CABLES IS BADLY KINKED.

TEMP P.O.L. EAST

DATE: AUG 77

BUOY # NONE FOUND

WATER DEPTH 75'

		1	2	3
BOTH LEGS ONE AND TWO SAME				
CABLE		1 3/4"	1 3/4"	1 3/4"
ABOVE ZINC	SL	2 1/2"	2 1/2"	2 1/2"
	DL	5"	5"	5"
1/2 WAY	SL	2 1/2"	2 1/2"	2 1/2"
	DL	5"	5"	5"
AT EQUALIZER	SL	2 1/2"	2 1/2"	2 1/2"
	DL	5"	5"	5"
A.J.L.		2 1/2"	2 1/2"	2 1/2"
SHACKLE		2 1/2"	2 1/2"	2 1/2"
SWIVEL		2 1/2"	2 1/2"	2 1/2"
SHACKLE		2 1/2"	2 1/2"	2 1/2"
SHACKLE		2 1/2"	2 1/2"	2 1/2"

SPECIAL NOTE: NO ZINCS ON EQUALIZER

TEMP P.O.L. WEST

DATE: AUG 77

BUOY # NONE FOUND

WATER DEPTH 55'

ALL MEASUREMENTS THE SAME AS EAST BUOY. SPECIAL NOTE: NO ZINCS ON EQUALIZER, ONE CAST ZINC ON ANCHOR LEG HAS STARTED TO JAM INTO EQUALIZER. THIS IS BECAUSE STOPPER LINK IS MISSING ON THAT LEG.

TEMP P.O.L. FUEL LINE MARKER

DATE: AUG 77

BUOY # NONE FOUND

WATER DEPTH 60'

		1	2	3
LEGS ONE AND TWO SAME				
AT CLUMP	SL	9/16"	5/8"	7/16"
	DL	1 7/16"	1 7/16"	1 7/16"
AT WEAR POINT	SL	11/16"	11/16"	5/8"
	DL	1 1/8"	1 1/4"	1 3/8"
AT BUOY	SL	5/8"	11/16"	11/16"
	DL	1 5/16"	1 7/16"	1 5/16"

SPECIAL NOTE: A LOT OF THE CENTE CROSS PIECES OF THE DIE LOCK CHAIN HAVE BEEN KNOCKED OUT.

PERM P.O.L. NORTH

DATE: AUG 77

BUOY # NONE FOUND

WATER DEPTH 85'

		1	2	3
LEG ONE				
AT ANCHOR	SL	2 5/8"	2 5/8"	2 1/2"
	DL	4 7/8"	5"	5"
AT GROUND RING	SL	2 7/16"	2 7/16"	2 7/16"
	DL	5"	5 1/16"	5 1/16"
AJOINING LINK		2 5/16"		
LEG TWO				
AT ANCHOR	SL	1"	1"	1"
	DL	2"	1 7/8"	1 7/8"
AT GROUND RING	SL	1"	1"	1"
	DL	1 3/4"	1 3/4"	1 3/4"
AJOINING LINK		2 5/16"		
LEG THREE				
CABLE		1 3/4"	1 3/4"	1 3/4"
BELOW EQUALIZER	SL	2 3/8"	2 3/8"	2 3/8"
	DL	4 5/8"	4 5/8"	4 5/8"
AJOINING LINK BOTH SIDES EQUALIZER SAME		2 5/16"		
LEG FOUR				
AT ANCHOR	SL	1"	1"	1"
	DL	2"	1 7/8"	1 7/8"
AT GROUND RING	SL	1"	1"	1"
	DL	1 7/8"	1 7/8"	1 3/4"

PERM P.O.L. NORTH CONT'D

		1	2	3
AJOINING LINK		2 5/16"		
GROUND RING		4 3/4"	4 3/4"	4 3/4"
RISER				
AJOINING LINK		2 5/16"		
ABOVE GROUND RING	SL	2 7/16"	2 7/16"	2 7/16"
	DL	4 7/8"	4 7/8"	5"
1/2 WAY	SL	2 7/16"	2 7/16"	2 7/16"
	DL	4 3/4"	4 3/4"	4 3/4"
AT BUOY	SL	2 1/2"	2 1/2"	2 1/2"
	DL	5"	5"	5"

SPECIAL NOTE: NO ZINCS ON EQUALIZER

PERM P.O.L. SOUTH

DATE: AUG 77

BUOY # NONE FOUND

WATER DEPTH 70'

		1	2	3
LEGS ONE AND TWO SAME				
AT ANCHOR	SL	1"	1"	1"
	DL	1 7/8"	1 7/8"	1 7/8"
AT GROUND RING	SL	1"	1"	1"
	DL	1 7/8"	1 7/8"	1 7/8"
GROUND RING		4 3/4"	4 3/4"	4 11/16"
LEG THREE				
CABLE		1 3/4"	1 3/4"	1 3/4"
BELOW EQUALIZER	SL	2 1/2"	2 1/2"	2 1/2"
	DL	4 3/4"	4 3/4"	4 3/4"
LEG FOUR				
AT ANCHOR	SL	2 1/2"	2 1/2"	2 7/16"
	DL	4 3/4"	4 3/4"	4 3/4"
AT GROUND RING	SL	2 1/2"	2 1/2"	2 1/2"
	DL	5"	5"	5"
RISER				
AT GROUND RING	SL	2 5/8"	2 5/8"	2 5/8"
	DL	5 1/3"	4 7/8"	4 7/8"
1/2 WAY	SL	2 1/2"	2 1/2"	2 1/2"
	DL	4 3/4"	4 5/8"	4 5/8"
AT BUOY	SL	2 1/2"	2 1/2"	2 5/8"
	DL	4 1/2"	4 1/2"	4 1/2"

SPECIAL NOTE: NO ZINCS ON EQUALIZER, ONE OF THE EXPLOSIVE ANCHOR CABLE IS NOT ATTACHED.

PERM P.O.L. EAST

DATE: AUG 77

BUOY # NONE FOUND

WATER DEPTH 75'

		1	2	3
LEG ONE				
BELOW GROUND RING	SL	2 1/2"	2 1/2"	2 1/2"
	DL	4 7/8"	4 7/8"	4 7/8"
LEG TWO				
BELOW GROUND RING	SL	2 1/2"	2 1/2"	2 1/2"
	DL	4 3/4"	4 7/8"	4 7/8"
LEGS THREE AND FOUR SAME				
CABLE		1 3/4"	1 3/4"	1 3/4"
BELOW EQUALIZER	SL	2 1/2"	2 1/2"	2 1/2"
	DL	4 7/8"	4 7/8"	4 7/8"
GROUND RING		4 3/4"	4 3/4"	4 3/4"
RISER				
AT GROUND RING	SL	2 1/2"	2 1/2"	2 1/2"
	DL	5 1/8"	5 1/8"	5 1/8"
1/2 WAY	SL	2 1/2"	2 1/2"	2 1/2"
	DL	4 7/8"	4 7/8"	5"
AT BUOY	SL	2 1/2"	2 1/2"	2 1/2"
	DL	4 7/8"	4 7/8"	5"

SPECIAL NOTE: STOPPER LINK MISSING PIN.

PERM P.O.L. WEST

DATE: AUG 77

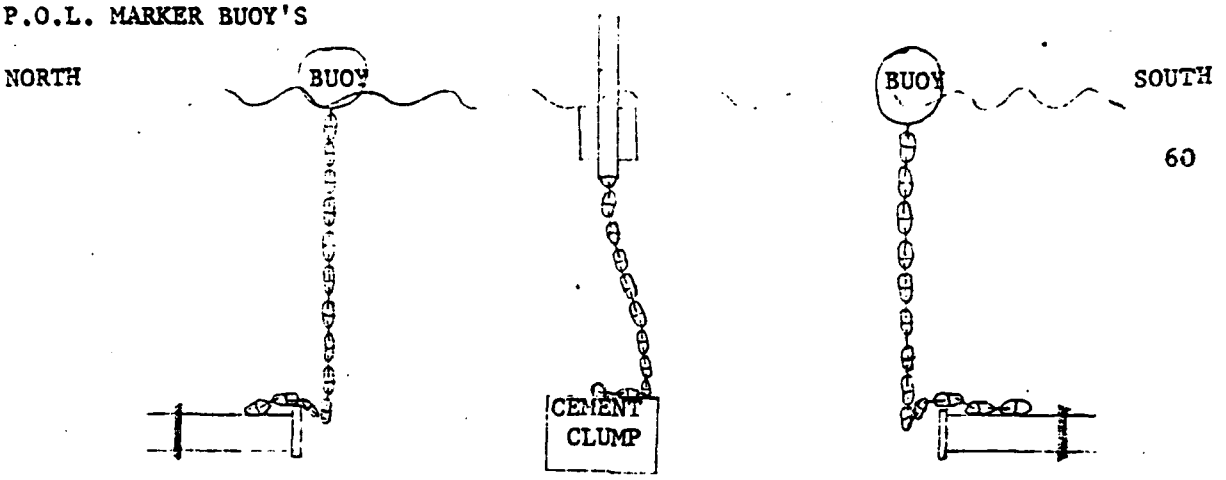
BUOY # NONE FOUND

WATER DEPTH 70'

		1	2	3
LEG ONE				
AT ANCHOR	SL	2 1/2"	2 1/2"	2 1/2"
	DL	5 1/8"	5 1/8"	5 1/8"
WEAR POINT	SL	2 1/2"	2 7/8"	2 1/2"
	DL	4 3/4"	4 3/4"	4 3/4"
LEGS TWO AND FOUR SAME				
AT ANCHOR	SL	1 1/16"	1 1/16"	1 1/16"
	DL	2"	2"	2"
WEAR POINT	SL	7/8"	7/8"	13/16"
	DL	1 5/8"	1 5/8"	1 5/8"
LEG THREE				
CABLE		1 3/4"	1 3/4"	1 3/4"
BELOW EQUALIZER	SL	2 7/16"	2 7/16"	2 7/16"
	DL	4 3/16"	4 3/16"	4 3/16"
GROUND RING		4 5/8"	4 5/8"	4 5/8"
ABOVE GROUND RING	SL	2 1/2"	2 1/2"	2 1/2"
	DL	5"	5"	5 1/8"
1/2 WAY	SL	2 1/2"	2 1/2"	2 1/2"
	DL	5"	5"	5"
AT BUOY	SL	2 1/2"	2 1/2"	2 1/2"
	DL	5"	5"	4 7/8"

SPECIAL NOTES: NO ZINCS ON EQUALIZER. LEG TWO HAS 17 LINKS WITH NO DIE LOCK CORSS PONS IN CENTER OF THE LINK LOCATED AT WEAR POINT.

P.O.L. MARKER BUOY'S



BOTTOM MEASUREMENTS

NORTH BUOY

GROUND WEAR POINT (BOUNCES ON GROUND)

SL	7/8"	7/8"	7/8"
DL	1 1/2"	1 1/2"	1 1/2"

HALF DEPTH

SL	1"	1"	1"
DL	2"	2 1/16"	2"

SURFACE BUOY

SL	1"	1"	1"
DL	2"	2"	2"

SOUTH BUOY

GWP

SL	7/8"	3/4"	7/8"
DL	1 1/2"	1 1/2"	1 5/8"

HALF DEPTH

SL	1"	1"	1"
DL	2"	1 7/8"	2"

SURFACE BUOY

SL	1"	1"	1"
DL	2"	2"	2"

SPAR BUOY

GWR

SL	7/8"	7/8"	15/16"
DL	1 1/2"	1 3/4"	1 3/4"

HALF DEPTH

SL	1"	1"	1"
DL	2"	2"	2"

SURFACE BUOY

SL	1"	1"	1"
DL	2"	2 1/16"	2"

ONE BUOY
BETWEEN MARINA AND TEMP P.O.L.

DATE: AUG 77

BUOY # NONE FOUND

WATER DEPTH 40'

		1	2	3
AT ANCHOR	SL	1"	1"	1"
	DL	2"	2"	2"
WEAR POINT	SL	7/8"	7/8"	7/8"
	DL	1 7/16"	1 3/8"	1 3/8"
1/2 WAY	SL	1 1/2"	1 1/2"	1 1/2"
	DL	2 3/4"	2 3/4"	2 3/4"
AT BUOY	SL	1 1/2"	1 1/2"	1 1/2"
	DL	2 3/4"	2 13/16"	2 3/4"

SPECIAL NOTES: THIS SERVES NO KNOWN PURPOSE AND SHOULD BE REMOVED, THE CHAIN COULD BREAK AND BECOME A SHIPPING HAZARD. THE CENTER DIE LOCK BARS ARE BROKEN OUT AT THE WEAR POINT AND THE CHAIN IS IN GENERAL VERY POORT SHAPE.

END

FILMED

6-86

DTIC